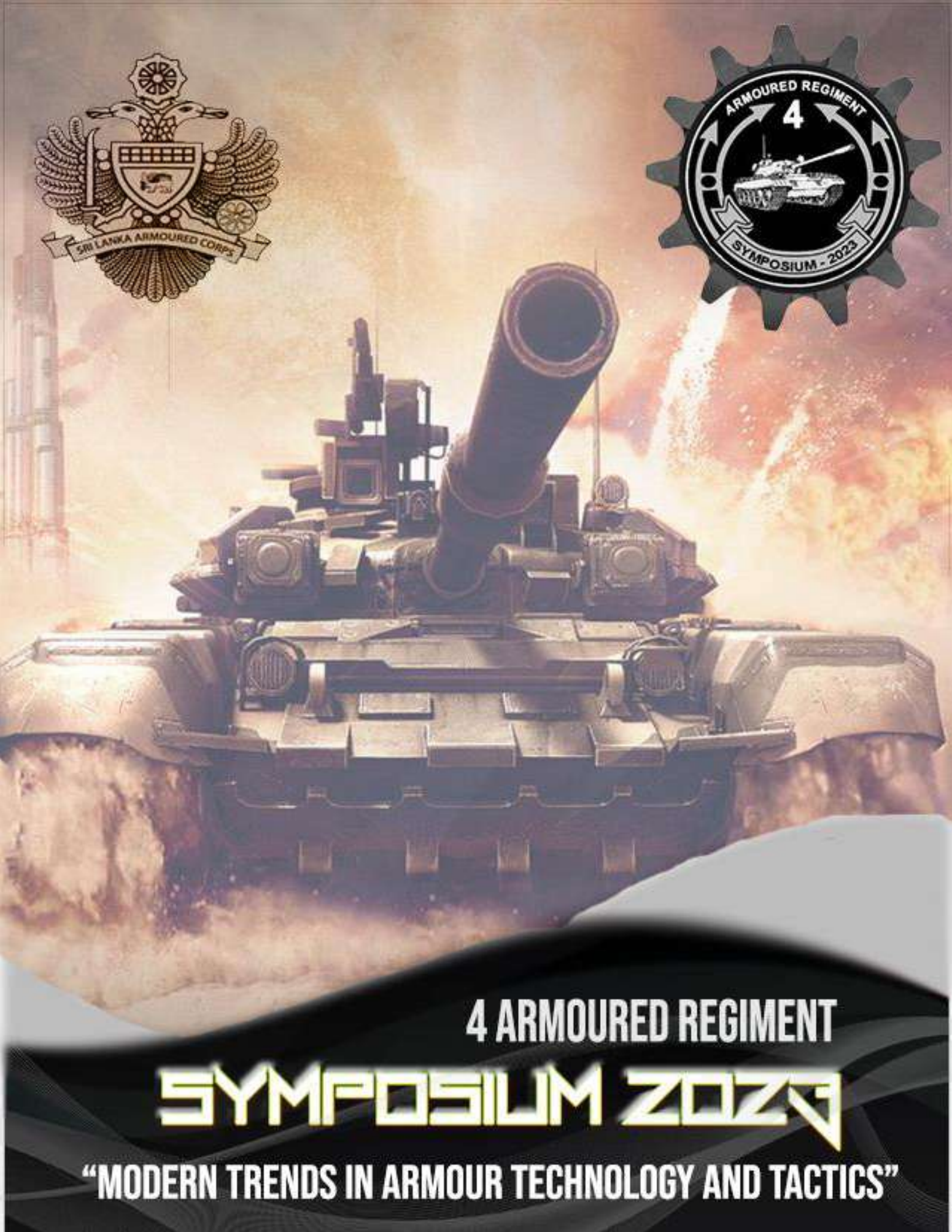

4 ARMOURED REGIMENT

SYMPOSIUM 2023

"MODERN TRENDS IN ARMOUR TECHNOLOGY AND TACTICS"

“Without technology tactics are helpless.

Without tactics technology is pointless”

- **General Friedrich Foertsch**

CONTENTS

FOREWORD BY THE COLONEL COMMANDANT

Training plays a pivotal role in grooming and developing effective military officers. Training needs to focus on holistic development of officers to equip them with the qualities, knowledge, and capabilities required to lead and make critical decisions. A well-groomed officer, forged through comprehensive training, stands as a pillar of strength in the defence of a nation's security and values.

Development of knowledge, skills and attitudes among young officers is of paramount importance in cultivating the future leaders in the Sri Lanka Armoured Corps. The foundation laid during their early years plays a crucial role in shaping their abilities to lead effectively and make significant contributions to their regiments, Corps, Army and the Nation at large. In this endeavour, Commanding Officers have a pivotal role to play.

Initiating a novel direction for officers training within the unit line, introduced the concept of 'Mini Symposiums' to conduct at the unit level. The primary objective of this approach is to provide targeted training for unit level Officers while imparting essential knowledge in them. Within this concept, there is a deliberate emphasis on Professional Advancement, Communication Skill Enhancement and Confidence Building.

Discussing "**Modern Trends in Armour Technology and Tactics**" is a crucial and relevant topic for Sri Lankan Armoured Corps officers. In today's rapidly evolving defence landscape, staying up-to-date with the latest trends and advancements in armoured tactics is essential for maintaining a competitive edge and ensuring the effectiveness of military operations. Modern-day warfare is undergoing a significant transformation, reshaped by advancements in cutting edge technology, evolving threats, and changing geopolitical landscapes. Therefore, staying abreast is critical to ensure operational effectiveness.

Possessing a profound understanding of one's field stands as a notable advantage for cavalry officers. Being a professionally qualified officer in all dimensions serves as a pivotal catalyst for thriving and distinguishing oneself amidst a fiercely competitive environment. Furthermore, my vision encompasses the dissemination of knowledge, with a particular focus on the profession of Armour, aiming to propel the professional growth of all officers. This endeavour also seeks to uphold and nurture the ethos, traditions and camaraderie intrinsic to cavalry officers within the Army.

Maj Gen SWM Fernando WWV RWP RSP VSV USP ndc psc
Colonel Commandant
Sri Lanka Armoured Corps

SESSION ONE

MODERN TRENDS IN ARMOUR TECHNOLOGY

MODERN TRENDS IN ARMOUR FIRE POWER AND INFORMATION SYSTEMS

MODERN TRENDS IN ARMOUR FIRE POWER AND INFORMATION SYSTEMS

by

Maj KBSSS Bandara psc

ABSTRACT

This study describes about the modern trends in the main battle tanks that applied against the advisories in order to dominate their firepower in the contemporary war environment. The basic principle of war is based on protection, mobility and firepower. In order to address them, world discovered latest technologies to the main battle tanks which is considered as the decisive factor to win the war. These new technologies enable the tank to perform well in a variety of intense combat situations, simultaneously both offensively and defensively. The present scenario of omni-directional and multidisciplinary threats and decreasing response time has made intelligence inevitable for the system to survive and win the war. The intelligence of the system calls for interface of refined logic with systems without compromising any parameters of the gun. However, much of the efforts and funds are directed towards developing the newer technologies to enhance the performance of weapon system in terms of accuracy, consistency, range, lethality and transportability. The efforts are also directed towards making smart weapons controlled distantly and cost effective. The future battlefields are going to be dominated by the technological advancements taking place and thus, the technological superiority over the adversaries will be the deciding factor to win the war. As tanks gain renewed attention due to the changing of present-day security environment that provokes military self-reflection and reorientation, through this paper it is discussed that the tank's technological advancement in order answer an existing and futuristic threats.

LIST OF ABBREVIATIONS

AFV	-	Armoured Fighting Vehicle
MBT	-	Main Battle Tank
ETC	-	Electro Thermal Chemical
EM	-	Electro Magnetic
KE	-	Kinetic Energy
LAHAT	-	Laser Homing Anti-Tank
ATGM	-	Anti-Tank Guided Missile
EW	-	Electronic Warfare
BMS	-	Battlefield Management System
FINDERS	-	Fast Information, Navigation, Decision and Reporting System

INTRODUCTION

1. In today's military context, nobody is thinking of close-quarter fighting and trends is towards indirect firing weapon system. Hence, future battlefields might be unrecognizable with the growth and advancements in new technologies. Moreover, the preferences are given to smarter weapon systems that are distantly guided and controlled, leading to zero damages to the service personnel. This basic principle is based upon the;

a. Protection.

b. Mobility.

c. Fire Power.

2. To meet the above requirement, world discovered Armoured Fighting Vehicles. Considering the first-generation tanks and fourth generation tanks today, it is seen that significant improvement have been made over the few decades such as; overall weight, power to weight ratio, average ground speed and specially gun calibre and shooting range etc.

3. Moreover, the gradual improvements in lethality, firing accuracy, consistency and advanced target acquisition systems have reduced the survivability time in intense combat environment. 120/125 mm gun still holds the strength as main weapon, but missile firing through gun, laser designator system, and advanced night vision system have come in place and play significant role in today's military context.

4. Further, to achieve all of the above tanks must have sound Command and Control. The communication systems serve as the foundation for that. In modern warfare communication equipment is the key to ensure effective Command and Control. With the rapid development of science and technology, the nature of the war has been changed. Hence, futuristic battlefields become more complicated and multi-dimensional. Particularly, the competition in electronic warfare grows more intensively.

SCOPE OF THE STUDY

5. This study focuses on the latest battle tanks used in the world and their capabilities specially in the field of gunnery, communication and information aspects. To achieve the primary role in the tanks in modern battlefield, the contemporaries are using latest technology to enhance its' lethality through the fire power and battlefield awareness through the different means of information equitation systems. Hence, this is an attempt to give an overview of the modern trends in the field of gunnery and communication of the Armoured tanks to the officers in the field.

OBJECTIVES OF THE STUDY

6. The objectives of the study are as follows:

a. To get an idea on the main armaments of the best Armoured tanks in the world.

b. To get an idea on the mechanism of the main armaments.

c. To know about various technologies required for tanks gunnery system.

d. To get an idea on the modern trends of military communication.

e. Importance of modern communication systems in military terms.

TECHNOLOGIES ADOPTED FOR THE MAIN GUN

7. The future battlefields are completely dominated by the technological advancements and its changes. Hence, the technological superiority over the adversaries will be the deciding factor to win the war (Roy, Lankennawar and Ghadge, 2017). It is no secret that the powerful countries in the world have taken advantage of the development of technology and have now used for their MBTs. Among them followings are the few factors to be considered:

a. Gun barrel with high muzzle velocity and high calibre.

b. Converted from riffled barrel gun to the smoothbore gun.

c. Stabilization, etc.

GUN BARREL WITH HIGH MUZZLE VELOCITY AND HIGH CALIBRE

8. To defeat the target at higher range and of higher magnitude there is a requirement of higher muzzle velocity. To achieve higher muzzle velocity following technologies have been taken place as par as modern trend is concern (Roy, Lankennawar and Ghadge, 2017):

9. Conventional gun barrel with higher chamber pressure, higher calibre and higher shot travel length.

a. Electro-Thermal-Chemical (ETC) gun.

b. Electro-magnetic (EM) gun.

c. Deferent types of ammunitions.

10. After the WW II, forecasting future demands and requirement of battle tanks, there was more concern about its main armament to destroy adversary's tanks. The result was progressive increases in the calibre of tank guns, the development of new types of ammunition with greater armour-piercing capabilities, and the introduction of more sophisticated fire-control systems to improve tank guns' ability to hit targets. The comparative statement of the size of main armament and its capability used in the main battle tanks in the world are as follows:

Parameter	Russia	France	UK	USA	Israel	German	China
Name of the Tank	Armatha	Leclerc	Challenger	M1A1	Merkava	Leopard 2	T 99
Type of gun	Smoothbore	Smoothbore	Riffled	Smoothbore	Smoothbore	Smoothbore	Smoothbore
Calibre	125mm	120mm	120mm	120mm	120mm	120mm	125mm
Direct range	NK	NK	6300 m	3280 yds	NK	6000 m	1900 yd
Indirect range	13000 yd	NK	NK	16000 m	NK	10000 m	3700 yd
Muzzle velocity	1900 m/s	1790m/s	1750m/s	1575m/s	NK	1750m/s	(755 m/s)

Table 1.1: Comparative statement of main guns features

11. While developing the capabilities of the main gun, manufacturing of ammunitions with new technologies are also been taken place. Thereby, the production of ammunitions is being made on the requirement basis, such as for the deferent types of targets and the gun barrels. The modern world is encountered with the following types of ammunitions for the tank gun:

HEAT HE HESH APDS APFSDS

Figure 1.1: Types of Ammo use for main gun
Source: defencexp.com (2023)

HIGH EXPLOSIVE ANTI -TANK (HEAT)

12. This shell used a shaped charge with a conical cavity that concentrated its explosive energy into a very high-velocity jet capable of piercing thick armour. HEAT projectile will not leave the muzzle with high velocity, as an armour-piercing round does. Thus, they can be fired by lower-powered weapons that generate less recoil.

HIGH EXPLOSIVE (HE)

13. HE (High Explosive) tank rounds are designed to destroy or damage enemy armoured vehicles and fortifications. They use a shaped charge to create an intense, focused jet of molten metal that can penetrate armour plate. They can also be used to engage soft targets such as infantry, buildings, and unarmoured vehicles.

HIGH EXPLOSIVE SQUASH HEAD (HESH)

14. HESH round is a type of explosive projectile with plastic explosive that conforms to the surface of a target before detonating, which improves the transfer of explosive energy to the target. Squash head projectiles are similar to high-explosive projectiles and are well suited to many of the same targets. However, while HESH projectiles are not armour-piercing, they can defeat armoured targets by causing spall, which can injure or kill a vehicle's occupants or detonate some types of ammunition.

ARMOUR PIERCING DISCARDING SABOT (APDS)

15. Armour-piercing discarding sabot (APDS) is a type of spin-stabilized kinetic energy projectile for anti-armour warfare. Each projectile consists of a sub-calibre round fitted with a sabot. The combination of a lighter sub-calibre projectile with a full-calibre propellant charge allows for an increase in muzzle velocity compared to full-calibre rounds, giving the round increased armour-penetration performance. To further enhance their armour-penetration capabilities, APDS rounds typically feature a hardened core made from tungsten or another hard, dense material.

ARMOUR PIERCING FIN-STABILIZING DISCARDING SABOT (APFSDS)

16. Armour-piercing fin-stabilized discarding sabot (APFSDS), long dart penetrator, or simply dart ammunition is a type of KE penetrator ammunition used to attack modern vehicle armour. Tanks kill other tanks with this type of ammunition using a combination of extremely high velocity, extremely heavy (for its size) and extremely hard and dense metal, typically depleted uranium. They just want to punch a hole through the armour and anything inside the tank that gets in the way.

17. The diagram below shows how the three main types of ammunitions perform against the target.

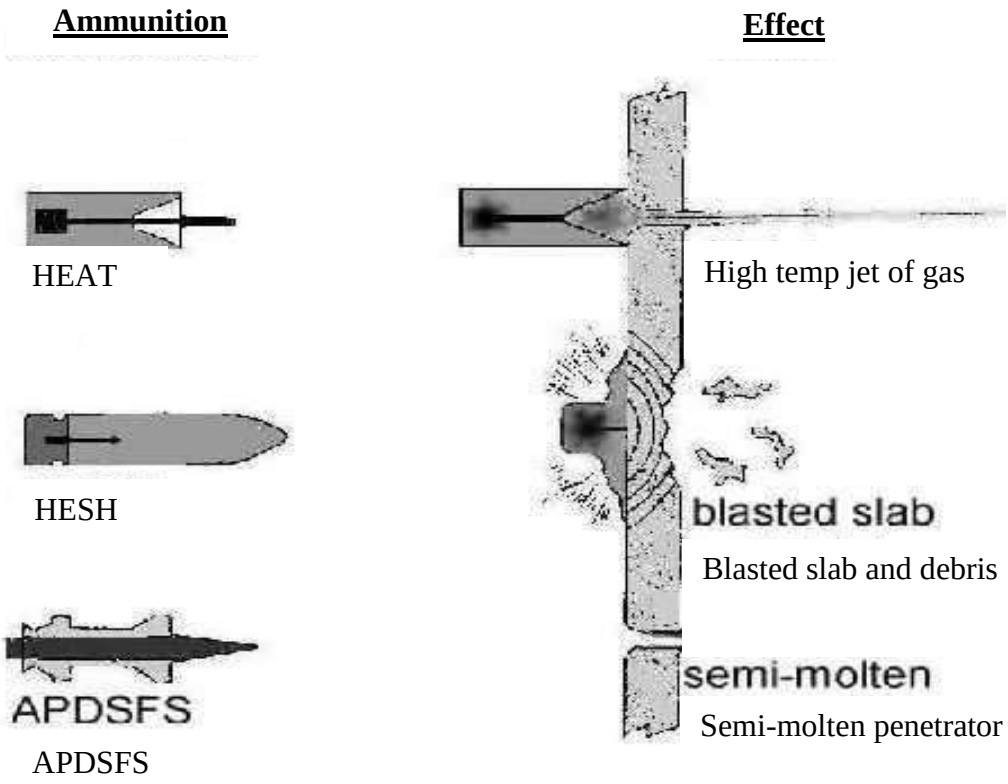

Figure 1.2: Main types of ammunitions perform against the target

Source: defencexp.com (2023)

CONVERTED FROM RIFFLED BARREL GUN TO THE SMOOTHBORE GUN

18. Older cannons were rifled in order to increase accuracy, but smoothbore cannons are capable of firing at higher velocities without making a bigger calibre. All modern tanks in the world except few use smoothbore cannons. Rifled guns are still in use, but technology has caught up that allows the advantages of Smoothbore guns to come into play while mitigating the disadvantages. Smooth-bore guns have the advantage of being better suited to firing fin-stabilized armour piercing rounds. There is also the added benefit of the barrels being able to last longer with reduced barrel wear compared to rifled guns.

19. The reason why rifled guns have all but disappeared is because that smooth-bore guns simply have so many more advantages. They are better suited to firing specific types of ammunition especially the APFSDS (Armor Piercing Fin Stabilize Discarding Sabot) rounds which are currently the best option when it comes to anti-tank performance. Further, latest smoothbore guns are existed with the ability to shoot anti-tank guided missile (Ex. The main gun of Leopard II has the ability of shoot Israel made missile - LAHAT) through its main gun. This gives the possibility to effectively engage targets at a range of 6,000 meters (20,000 ft). However, these both are using in the world today and have deferent advantages.

a. **Advantages of Rifled Guns**.

(1) They can fire obsolete ammunition more accurately.

(2) Obsolete HE/HEAT/HESH ammunition is cheaper than fin-stabilized.

b. **Advantages of Smoothbore Guns**.

(1) Higher chamber pressure resulting in greater speed for ammunition.

(2) Superior APFSDS performance.

(3) Superior HEAT performance.

(4) Less barrel wears.

(5) Cheaper to produce.

(6) Larger internal calibre.

Figure 1.3: Difference between rifled and smoothbore guns

Source: reddit.com (2021)

Figure 1.4: Merkava 4 launching LAHAT ATGM from smoothbore gun

Source: defense-update.com/ (2023)

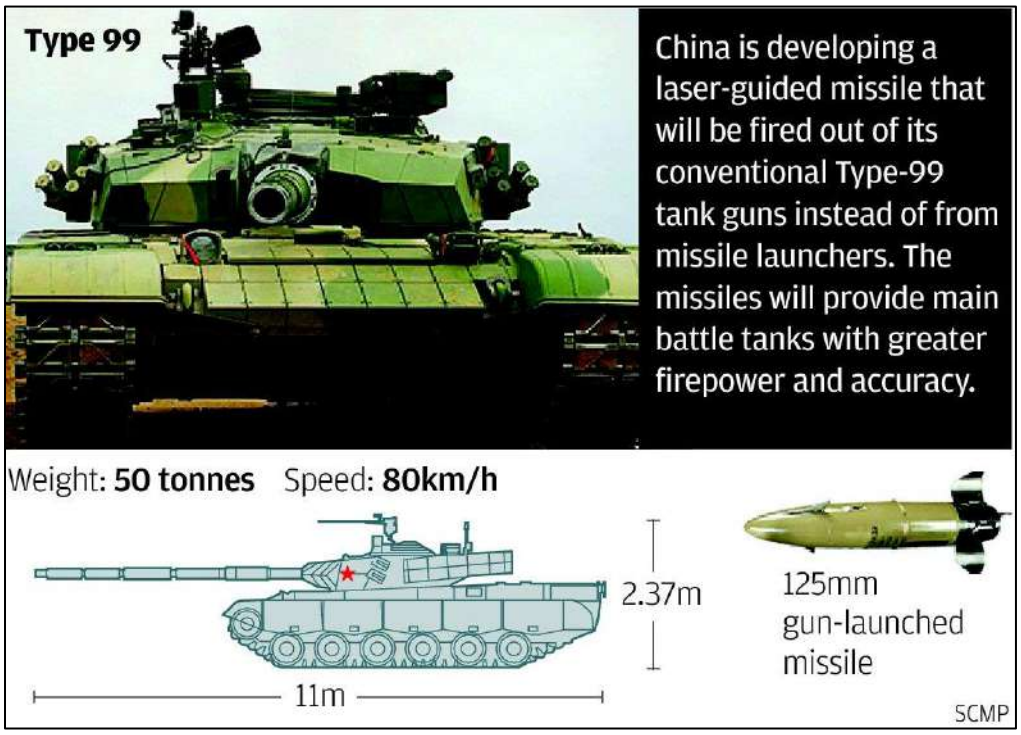

Figure 1.5: T90 next generation laser guided missile

Source: scmp.com (2023)

STABILIZATION

20. High targeting and hitting accuracy for a main battle tank is important in the battlefield while the tank is on the move. This can be achieved by the proper design of both fire control system and the gun system. In order to design an effective gun system, better understanding of the dynamic behaviour of the gun system is required. Further, Control systems of the tank gun become more important while the system become larger and more complex.

21. In early stage, tanks were fitted with stabilized gun controls to enable them to fire more accurately on the move. It's basically to keep their gun barrels at a constant angle of elevation even while the tank was riding over bumps or depressions. At first some tanks, such as the T-54, had their guns stabilized only in elevation. The Centurion was the first tank that had stabilization in traverse as well as elevation, and this became standard beginning in the 1970s. Later tanks were also provided with independently stabilized gunners, as well as commanders, sights, the better to engage targets on the move.

STABILIZATION OF ELECTRO-OPTICAL SENSOR

22. An innovative concept in stabilization technology for electro-optical sensor systems is achieving these benefits with a design that is significantly more compact and consumes less power than concurrent designs. Armored vehicles utilize stabilized electro-optical sensor systems for aiming and targeting, surveillance, situational awareness, and for observation purposes.

23. When driving through rough terrain, the electro-optical sighting systems have to be stabilized in order to maintain a stable line of sight and keep track of the target. The traditional design has been to place these sighting systems on motorized stabilization platforms. The system sometimes contains its own gyroscope, or alternatively it can receive signals from the turret's gyroscope. Software determines the degree of positioning correction required and controls motors to exert equal and opposite force to the impact of the environment in order to maintain alignment with the object insight.

Figure 1.6: Stabilize electro optical targeting system
Source: hensoldt.net (2023)

NIGHT SIGHT CAPABILITY AND RANGE FINDERS

24. After the decades of experience tanks adopted optical range finders as advance in fire-control systems. It was first used for M47 tank and later for the Leopard 1, AMX-30 and other tanks. Based on the needs of the battlefield, optical range finders began to be replaced by laser range finders in around 1960. With the introduction of laser range finders with combination of electronic ballistic computers, the hit probability of the tanks was greatly increased. They became standard in all new tanks built from the early 1970s and were retrofitted in many of the earlier tanks.

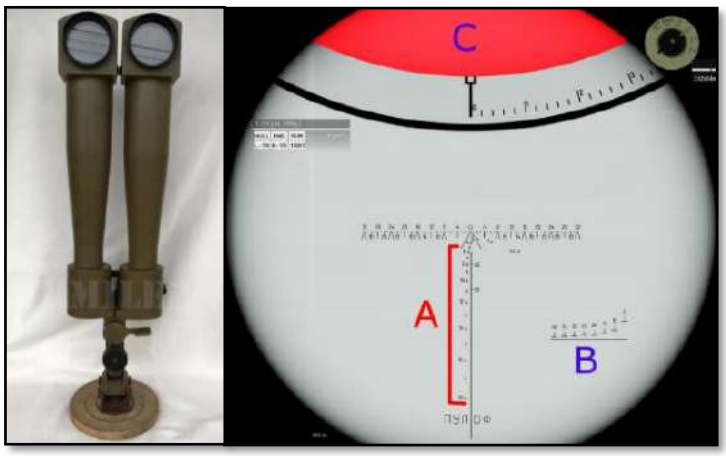

Figure 1.7: Optical range finder and its' view
Source: britannica.com (2023)

Figure 1.8: Laser range finder

Source: britannica.com (2023)

25. Today in many modern tanks are equipped with radar range finders and laser range finders to provide redundancy and boost up the chances of successful range findings. Radar range finders work by emitting radio waves and measuring the time it takes for them to bounce back from an object. It can be done by different ways, one of them is by using the doppler effect, which allows to measure the velocity of a moving target. Radar range finders several advantages over laser range finders such as operate in a wider range of conditions in bad weather, fog or dust. Meanwhile, they can also detect target that are partially obscured by foliage camouflage and target in long range.

26. It is obviously that the tanks having limitation of night fighting capability. In response to that the major development was taken place with night sights, which enabled tanks to fight in the dark as well as in daylight. Large scale of Soviet tanks was first adopted the active infrared type sights. Later, other tanks were fitted with image-intensifier sights and from the 1970s with thermal imaging sights. These latter were called passive because, unlike active infrared systems, these sights did not emit energy and were not detectable.

Figure 1.9: Development night vision device and thermal sight

Source: warthunder.com (2023)

MODERN TECHNOLOGIES ADOPTED FOR FIRE CONTROL AND TARGET ACQUISITION

27. A modern tank's Fire Control System (FCS) typically includes a number of components, such as:

a. A gunner's primary sight (GPS), which facilitates the tank crews to aim and fire the main gun with precision.

b. A commander's independent sight (CIS), which allows tank commander to observe and engage targets independently of the gunner.

c. A laser rangefinder, which measure the distance to a target for accurate firing.

d. A ballistic computer, which calculate the trajectory of the main gun based on factors such as the range to the target, the temperature and humidity and the tank's movement.

e. A stabilization system, which keep the main gun steady while the tank in moving. In addition to all above components, modern tanks may also include various sensors too.

28. Further, the FCS in the tank works when a computer takes in a number of inputs, including very exact positional data about the movement of the tank and the direction the gun is pointing, plus a range of other environmental inputs like temperature, humidity etc. From this it can calculate exactly where a round would go if fired at that moment. The gunner has a stabilized sight and a laser rangefinder. They put the reticule on the target and lase it. This gives the FCC the exact range and from that it computes a firing solution which will put the shot exactly on the point the gunner is lasing. The system adjusts the gun onto that firing solution and fires.

29. Automatic target tracker (ATT) is one of improvement in main battle tank which facilitates to acquire moving target. The purpose of an ATT system is to maintain a stable image sensor-to-target line of sight (LOS) in the presence of relative target motion and base motion disturbance to the sensor platform due to severe terrain conditions in the war field. The proposed system works on the real time video which is acquired through Tank Sight system. ATT performs Normalized Area Correlation algorithm on real time video and computes the deviation of target with respect to bore-sight (tracking window) and sends error signal to the Main Sight System. This error signal replaces the Gunner's command signal. Then it will detect all objects in images no matter whether they are moving or not. The proposed technique ensures robust tracking of the ground target in a complex background in the war field.

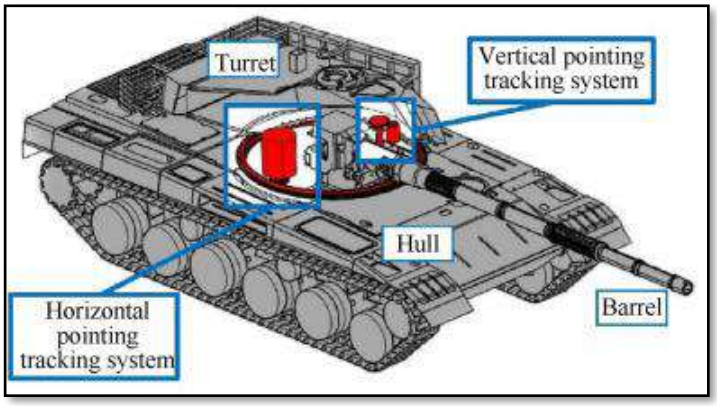

Figure 1.10: Adaptive robust Automatic Target Tracking system for in tanks
Source: sciencedirect.com (2023)

TECHNOLOGIES ADOPTED IN MODERN TANK COMMUNICATION AND INFORMATION SYSTEMS

30. Communication systems serve as the foundation of the commanding, like a natural network of armed forces. The communicating efficiency effects directly the result of commanding and operating. Radio communication is the primary means of communication for tanks. Each tank is capable of transmitting and receiving on one frequency while simultaneously receiving on another frequency. The heavy reliance upon radio communications for command, control and coordination of tank make them vulnerable to enemy electronic warfare in modern battlefield is concern. Hence, the tank commander and crew must be able to operate in a hostile EW environment with employ communication security procedures to overcome such limitations. At the same time, they have the responsibility of quickly identifying enemy targets and destroying them. The modern communication equipment used for Armoured tanks will facilitate its' crews to get quick and reliable information on target. Moreover, it provides the external factors such as direction of the target, determining the distance and calculating wind speed and directions etc, which are affecting to destruction of the target.

31. With the advancement of the latest technology on communication and information fields, the modern battle tanks are fitted with sophisticated equipment which are highly essentials for fire control systems. Fire Control Systems plays a critical role in the battle effectiveness of a Main Battle Tank whether it is high first round hit probability, ballistic solution computation for projectile trajectory, or moving target engagement. In modern tank, the fire control system comprises of fire control computer, sensors, and gun controller. Fire control computer computes the elevation and azimuth (pitch and yaw axis) angles, based on the ballistic algorithm. The fire control computer computes the ballistic solution for static and moving targets and it can be commonly seen in the tanks comprised with 125 mm smoothbore gun (Jattala, Farooqi, 2013).

32. Initially the tanks were adopted optical range finders and later it was replaced by laser range finders. In combination with electronic ballistic computers, these greatly increased the hit probability of tank guns. The rangefinder can provide up to three range values in four seconds.

The range data is transmitted to the fire control computer and is used to calculate the firing algorithms. Also, because the laser rangefinder is integrated into the gunner's primary sight. Hence, the gunner can read the digital range measurement directly.

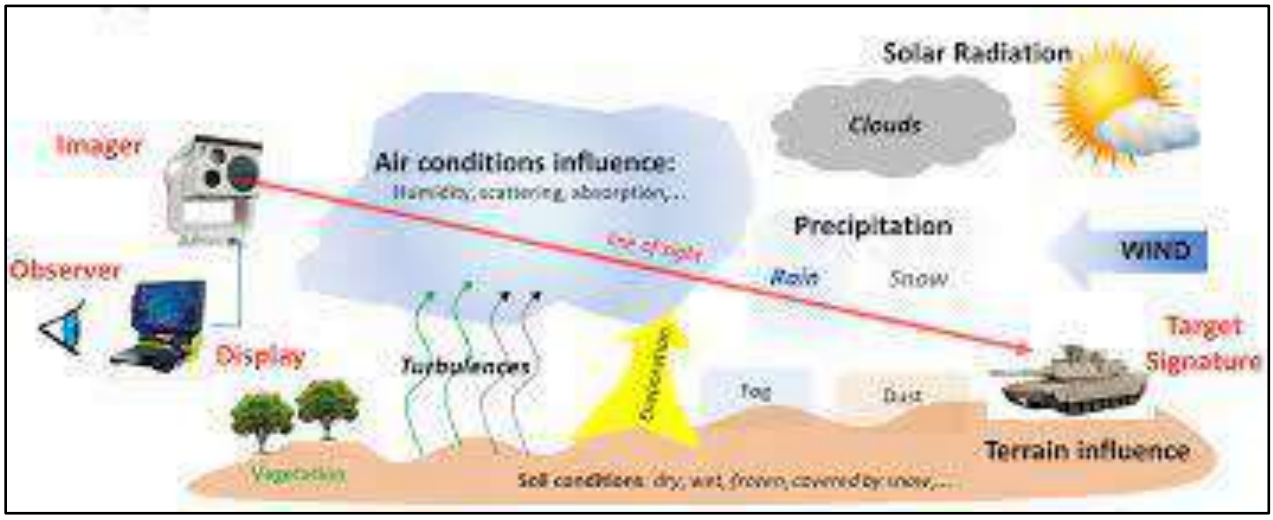

Figure 1.11: Thermal image range; Prediction, expectation and reality
Source: mdpi.com (2019)

BATTLEFIELD MANAGEMENT SYSTEM IN MODERN TANKS

33. Battlefield Management System is the system of information acquisition and processing to enhance command and control in military field. A fully established BMS will be facilitated for the battlefield transference which is the concept in military operations where advanced technology is utilized to improve situation awareness and provide real-time information about the battlefield to all stakeholders. Situational awareness in the battlefield of own forces and threats in real time is key to combat superiority and for survival (Ramesh, 2017).

34. Some of the modern tanks such as Leclerc is fitted with the FINDERS (Fast Information, Navigation, Decision and Reporting System) battlefield management system. FINDERS includes a colour map display which shows the positions of the host tank, allied and hostile forces and designated targets and can be used for route and mission planning.

Moreover, Terminal Information System is use to exchange of digitized data including tactical situation and the graphic orders displayed on a background map, between the vehicle and higher-level command.

35. Battlefield Management System (BMS) used in the main battle tanks and the field units to increases the coordination of all units and troops involving in operations. The system provides digital command capability with voice and data communications, real time situational awareness and functions for operations planning and execution. The main components of the BMS for the main battle tanks are:

a. Command Control Computer.

b. Command Control Software.

c. Software Defined Tactical Radios.

d. Vehicular Intercom System.

e. Display Units.

36. BMS provides full integration with the tank platform electronic subsystems such as Fire Control System, Remote Weapon Station, Target Sensors and other sensors of the tank platform, enabling the automated use of sensor and platform information for command and control. The main features of the BMS are:

a. Real time situational awareness.

b. Operation plan/order and overlays creation and dissemination.

c. Military reports and messages.

d. Logistics and personnel reports and functions.

e. Movement planning and control.

f. Decision support tools and functions.

g. Modular and configurable system software.

h. Open system architecture and use of common standards for interoperability.

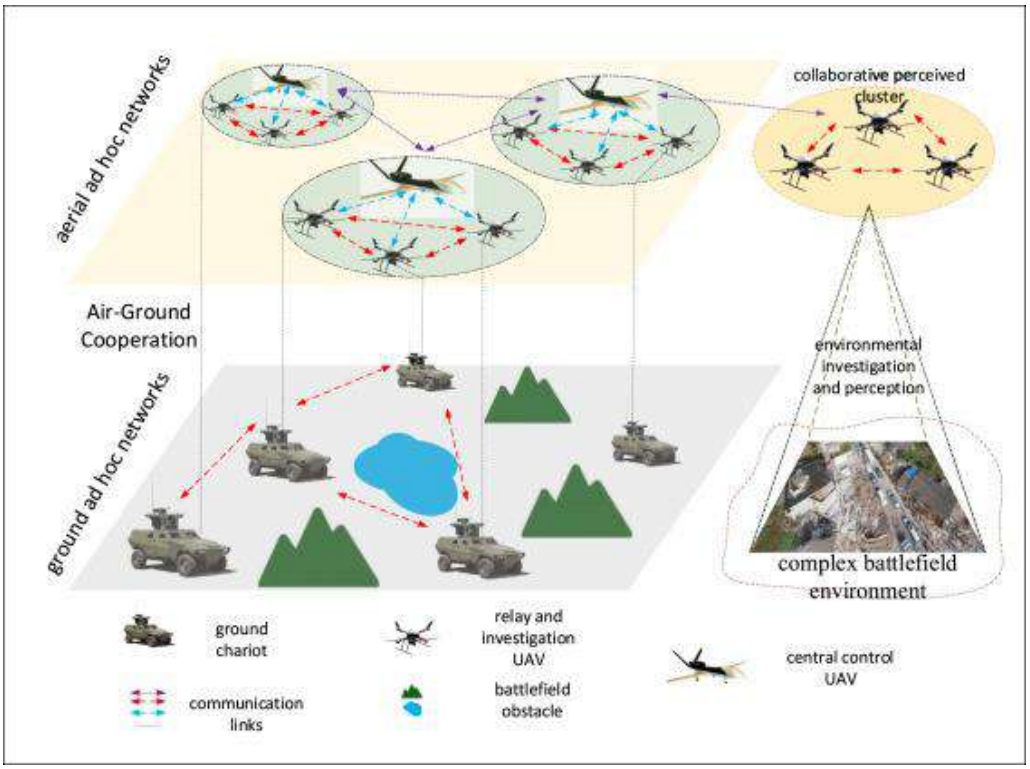

Figure 1.12: Battlefield situation awareness and network based on agent distributed computing

Source: sciencedirect.com (2019)

Figure 1.13: Leopard 2A7 tank inside with BMS

Source: steelbeasts.com (2019)

CONCLUSION

37. The battlefields in contemporary world are completely dominated by the technological advancement taking place in the equipment use. There too, armoured tanks with heavy firepower play an important role in the field. Modern tanks armed with powerful weapons, allowing them to face wider range of dangers on the battlefield with considerable lethality. However, the improvisation of the systems in the tanks with latest technology have been provided more comfortability to the crews. Moreover, the latest communication and information acquisition systems in the tanks also provided accurate battlefield awareness to the commander in order for him to make quick decisions. However, the conventional weapon system with higher degree of intelligence will be first and foremost choice for present as well as futuristic combat system.

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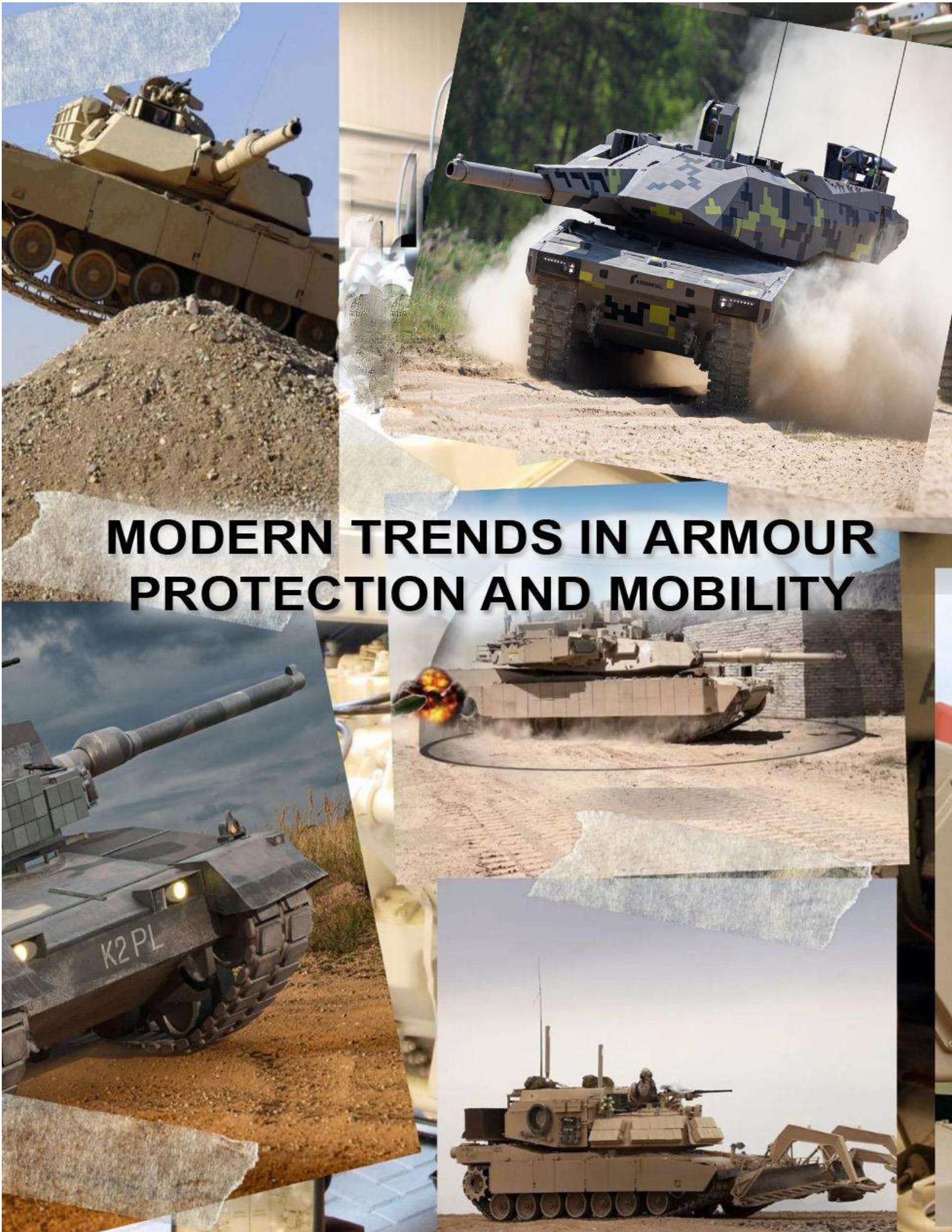
MODERN TRENDS IN ARMOUR
PROTECTION AND MOBILITY
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MODERN TRENDS IN ARMOUR PROTECTION AND MOBILITY

by

Maj PLKM Jayakody psc

ABSTRACT

An outstanding shift in armoured mobility and protection has been driven by technology improvements. The transition from ancient leather and metal armours to contemporary composite materials has been characterized by the quest of improved protective and mobility capabilities. The present paper investigates the evolution of armoured protection and mobility throughout history and examines current trends, emphasizing significant advancements. Beginning with an acknowledgement of the crucial function armoured vehicles which offer protection and tactical versatility play in military operations. The capacity of these vehicles to defend against anti-armour threats has been considerably improved by innovations like composite ceramic plates, Active Protection Systems (APS), reactive armour and electro-optical vision system. The constant quest for better protection is shown by the incorporation of cutting-edge armour materials including Nano-ceramic composites, materials with graphene infusions, metal matrix composites, and fibre-reinforced polymers. Equivalently revolutionary changes have been made to armoured mobility. Systems for electric hybrid propulsion have evolved, improving environmental sustainability and fuel efficiency. Convoy efficiency and safety are being transformed by semi-autonomous convoy operations, which combine manned lead vehicles and unmanned autonomous following. For successful navigating of complicated cityscapes, urban mobility and climbing skills have been redefined. Swarm intelligence is one example of how artificial intelligence and armoured combat are converging. Autonomous armoured vehicles can function together and adapt to changing combat situations because of AI-driven swarm systems. This cutting-edge strategy offers flexible solutions to challenges and dangers, assuring excellent battlefield performance. Research and development initiatives in these fields promise to transform the future of armoured combat as the twenty-first century progresses.

Keywords: Armoured protection and mobility, Active Protection Systems (APS), Electro-Optical Vision System, Use of AI Technologies

LIST OF ABBREVIATIONS

AI	-	Artificial Intelligence
APC	-	Armoured Personnel Carriers
APU	-	Auxiliary Power Unit
APS	-	Active Protection Systems
AFV	-	Armoured Fighting Vehicles
ASPIS	-	Advanced Shielding Platform Integrated System
AT	-	Anti Tank
BFV	-	Bradley Fighting Vehicles
EM	-	Electro-Magnetic
FRP	-	Fibre-Reinforced Polymers
IED	-	Improvised Explosive Device
MBT	-	Main Battle Tank
MGCS	-	Main Ground Combat System
MMC	-	Metal Matrix Composites
MUSS	-	Multifunctional Self-Protection System
SETAS	-	See-Through Armour System
SI	-	Swarm intelligence
UAV	-	Unmanned Aerial Vehicles
US	-	United State
UGV	-	Unmanned Ground Vehicle
WWI	-	World War I
WWII	-	World War II

INTRODUCTION

1. For many years, armoured vehicles have been treated as the pillar of contemporary military operations, that offer significant protection capabilities and strategic flexibility in a variety of combat situations (Mitcham, 2013). These vehicles have seen notable improvements in armoured protection and mobility due to the consequence of ongoing technological enhancements, that enable military forces to successfully work on the global threats and issues (Ghazanfar, 2020). Innovative technologies have been integrated into armoured vehicles over time, including composite ceramic plates, Active Protection Systems (APS), and reactive armour. These enhancements significantly improve their responsiveness to anti-armour weapons and explosives.

2. The use of cutting-edge armour materials has widely enhanced the protection capacities of present armoured vehicles (Song et al., 2021; Sabath, 2018). Another vital concern in the development of armoured vehicles can be identified as mobility (Hou et al., 2019). Additionally, improvements in autonomous technology have made it possible and easy for robotic and optionally-manned armoured vehicles, decreasing the dangers and risks for human operators and creating new opportunities for ground-based combat (Collins et al., 2022; Bradshaw et al., 2018). As the twenty-first century unfolds, the evolution of armoured vehicles is poised to exert a sustained impact on the landscape of combat. In light of this prospect, the enduring significance of these resilient armoured platforms is anticipated to persist on a global scale. This endurance hinges upon the directed endeavours in research and development, aiming to enhance protective attributes, amplify mobility, and seamlessly integrate AI (Artificial Intelligence) functionalities.

SCOPE OF THE STUDY

3. The historical expansions and current developments in armoured protection and mobility are examined in this paper. It focuses on developments in armour technologies including next-generation composite materials, molecular nanotechnology coatings, active protection systems, and electro-optical vision system as well as innovations in multifunctional self-protection systems.

4. This study also investigates the effects of semi-autonomous convoy operations, AI-driven swarm intelligence, and electric hybrid propulsion technologies on armoured mobility.

OBJECTIVES OF THE STUDY

5. Several objectives were formulated to conduct this study in a meaningful manner. The general and specific objectives of the study are mentioned as follows.

a. Evaluate the advancements of armoured protection.

b. Evaluate the advancements of armoured mobility.

EVOLUTION OF ARMOURED PROTECTION AND MOBILITY

ANCIENT ARMOURED PROTECTION

6. Ancient armoured defences were mostly made of leather, metal, and animal skins. Early societies employed basic leather or animal-hide scaled armours to provide rudimentary defence against projectiles and melee weapons, such as the ancient Egyptians and Assyrians. Mail and plate armours were developed in ancient Greece and Rome as a result of the popularity of using bronze and iron to make more durable armoured items. However, the wearer's movement was limited by the weight of the armour (Oakeshott, 1980; Cummins, 2009).

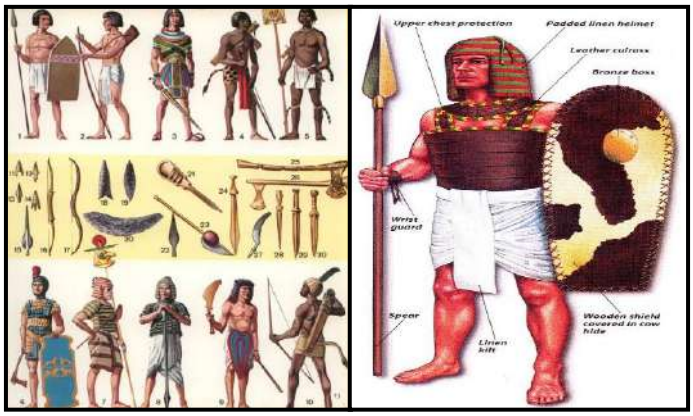

Figure 1.1 : Armour gears used by ancient Egyptians

Source: Hotcore.info (2023)

MEDIEVAL ADVANCEMENTS IN ARMOURED PROTECTION

7. With the invention of complete armour plate in the 14th century, armoured protection underwent tremendous advancements during the medieval era. Armour Plate, which covered the full body and was made for knights, offered the best defence against arrows and sword attacks. Due to its articulated construction, this invention gave fighters the ability to endure strong strikes while still having some degree of movement. However, the weight of armour plates continued to restrict mobility which was a disadvantage (Oakeshott, 1980; Cummins, 2009).

Figure 1.2: Armour gears used in medieval era

Source: Pinterest (2012)

RENAISSANCE AND GUNPOWDER ERA

8. Armour protection was altered with the introduction of gunpowder weaponry during the Renaissance. Traditional armour plate was less efficient against explosive when armed. Armoured protection developed in response, including materials like hardened steel and stacked iron plates that are bulletproof. Due to this advancement, "cuirassier" armour was developed, combining plate armour with weapons to increase battlefield survival (Tucker, 2017).

Figure 1.3: Cuirassier Armour

Source: SchumiMike (2021)

INDUSTRIAL REVOLUTION AND ARMOURED VEHICLES

9. Armoured mobility and protection underwent a paradigm shift during the Industrial Revolution. More powerful materials could be produced because of developments in metallurgy and heavy industries. In the late 19th and early 20th centuries, this cleared the way for armoured vehicles like Armoured Fighting Vehicles (AFVs) and Armoured Personnel Carriers (APCs) (Orr, 2018). The invention of tanks during World War I significantly changed armoured mobility and protection.

10. By breaking the trench warfare stalemate on the western front, the invention of tanks, which combined bulletproof armour, internal combustion engines, and caterpillar tracks, changed combat during World War I (WWI). Although they were sluggish, WWI tanks could breach opposing trenches. The single rotating turret design first appeared in the 1920s as a result of design work aimed at enhancing mobility and crew comfort. More tank designs emerged as a result of the rearmament competition in the 1930s, with the Russian BT-5 emerging as a standout.

11. Tanks with different gun calibre and armour thicknesses were used during World War II (WWII), with the Soviet T-34 being the most popular design. In reaction to the T-34's effectiveness, the German Tiger and the American M4-Sherman were created.

ARMOURED PROTECTION & MOBILITY IN MODERN WARFARE

12. Following World War II, technological developments in materials, propulsion, and computation accelerated the development of armoured protection and mobility. Modern armoured vehicles now have better mobility and cross-country capabilities because to powerful engines and sophisticated suspensions (Hart, 2018). Improved defences against shaped-charge projectiles and missiles were provided by reactive armour and active protection systems. Dynamic safeguards intercept and divert dangers before they reach the vehicle, whereas reactive armour neutralizes approaching hazards with explosive devices (Hoffman, 2017).

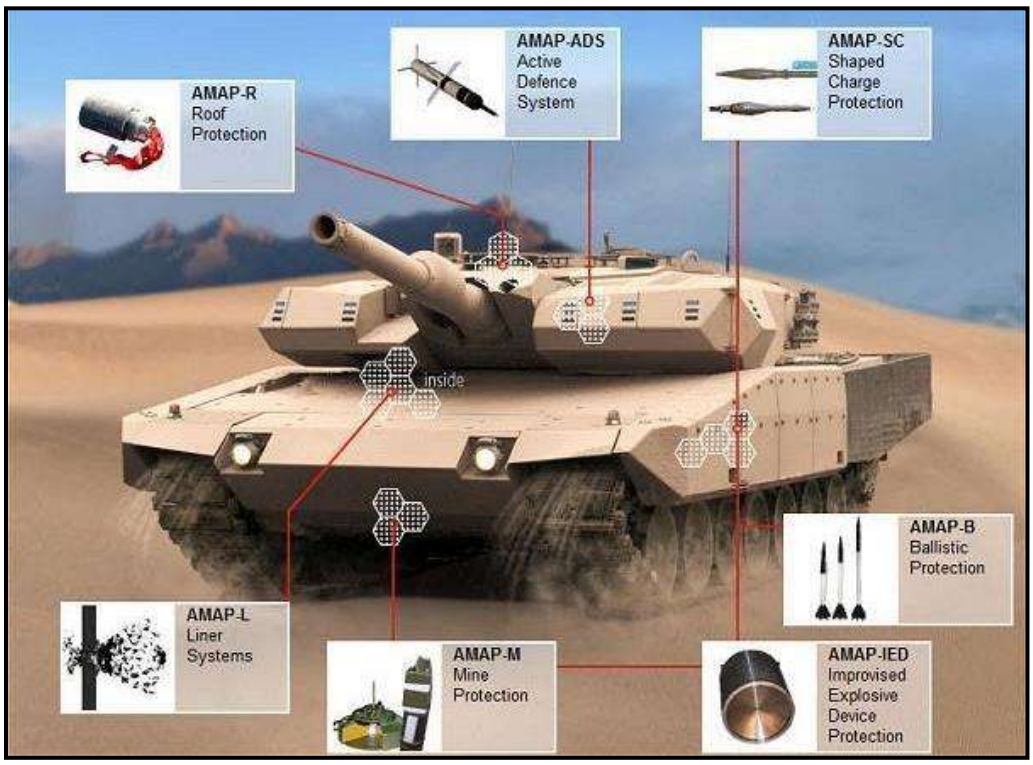

Figure 1.4: Modern Technologies

Source: Anadolu (2022)

FUTURE TRENDS IN ARMOURED WARFARE

13. Armoured mobility and protection continue to advance rapidly. The trade-off between mobility and protection may be redefined by light yet powerful materials such as graphene and carbon nanotubes (Hoffman, 2017). It is anticipated that autonomous and semi-autonomous armoured vehicles will allow novel tactical methods and lower danger to human personnel onboard. The creation of electric or hybrid-powered armoured vehicles may increase their sustainability and operating range (Hoffman, 2017). Therefore, it is clear that the development of armoured protection and mobility has a long history and will continue to develop in line with the most recent technological advancements.

Figure 1.5: Future Trends

Source: Nonothai (2020)

ADVANCEMENTS IN ARMOURED PROTECTION

NEXT-GENERATION COMPOSITE MATERIALS

14. The development of next-generation composite materials has significantly altered the design of modern armoured vehicles, enhancing their protection. Nanomaterials and carbon-fibre composites have changed the game by providing unmatched strength-to-weight ratios when compared to conventional materials like steel (Bao et al; 2021).

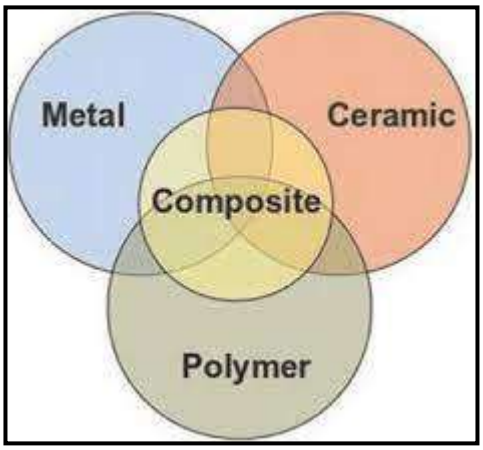

Figure 1.6: Structural Diagram
Source: Kumar and Dixit (2019)

15. In addition to offering strong ballistic protection, these cutting-edge materials also allow armoured vehicles to preserve agility and flexibility, two essential qualities in contemporary combat. Armoured vehicles are now more adaptable and able to carry out lengthy operations because of the incorporation of these materials into vehicle construction, which has also led to decreased weight and increased fuel economy. Few of the composite materials are as follows;

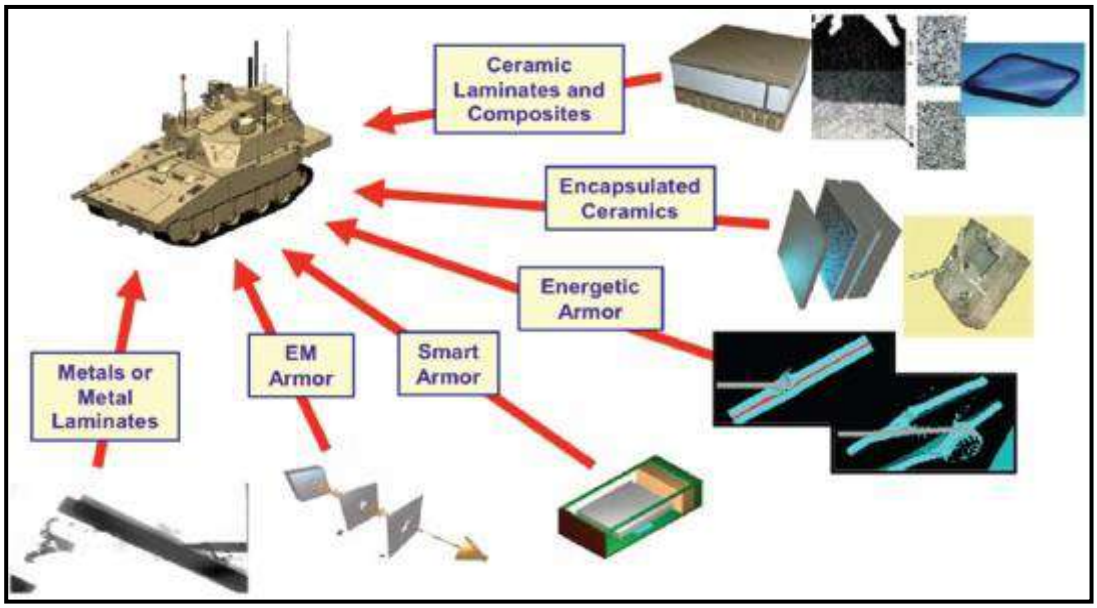

Figure 1.7: Composite Materials

Source: Yang (2021)

a. **Nano-Ceramic Composites**. These composites integrate nanoscale ceramic particles into a polymer matrix, resulting in materials with enhanced hardness and impact resistance. For instance, the U.S. Army has explored Nano-ceramic composite armour for vehicles like the M1 Abrams tank.

b. **Graphene-Infused Materials**. Graphene, a single layer of carbon atoms, is known for its remarkable strength and conductivity. Researchers have been working on integrating graphene into armoured vehicles to create lighter yet stronger protection.

c. **Metal Matrix Composites (MMCs)**. MMCs combine metals like aluminium or titanium with ceramic reinforcements such as silicon carbide or alumina. The Russian Armata T-14 tank employs MMCs in its armour to improve performance.

d. **Fibre-Reinforced Polymers (FRPs)**. FRPs, often using carbon or aramid fibres, are embedded in a polymer matrix to create lightweight yet sturdy composite materials. The British Ajax armoured fighting vehicle utilizes FRPs in its hull, enhancing protection while maintaining mobility.

ASPIS MODULAR (ADVANCED SHIELDING PLATFORM INTEGRATED SYSTEM

16. The threat to tank and tank crews have increased many times in recent years. In the new generation of armoured vehicles, the approach to protection and overall survivability should be "holistic" based on many technological stages of tackling a threat with multi-zone and successive stages of defence. This system has innovated by the EODH company located at Greece as an integrated self-protection system includes masking and signature repression technologies across the range of enemy sensors (acoustic, optical, infrared, and electromagnetic). Also, a wide range of sensors for early detection, tracking, and acquisition of threat, an electronically-automated, with artificial intelligence assesses incoming information, combines them with those received from the C3I System and reacts instantaneously. At the last level, we have the destructive inhibition of the threat by "Hard Kill" system part of the active self-protection systems that intervene in the final phase of the missile's course toward the target and destroy it or cause damage that significantly reduces its effectiveness.

17. If defence zones fail, the incoming threat usually hit the target and the new generation multilayer protective shields are activated and the structure of armour made from High strength, special alloys and composite materials incorporating nanotechnology structures are interacting by altering the penetration force and angle ultimately defeating the Threat. The ASPIS system is able to detect, classify and prioritize any incoming Threat, face it from the initial stage of the attack by measures and countermeasures. If the Threat proceeds then the first active defence zone, suppresses it with the Active Self-Protection System that is automatically activated a few meters away from the vehicle.

18. ASPIS integrated Protection System with the use of a New Generation of Passive and Active Protecting Materials. Also integrates the special Anti-mine Protection Design, combined with anti-shock Seats that are supported by innovative arms that absorb an amount of the explosion, protecting the transported personnel from neck and spinal injuries. In addition, the advanced roof shield is designed to provide protection against fragments from time-fused artillery munitions, shaped charge bomblets, and insults from light A/T launchers, fired from building terraces in urban warfare scenarios. This system is already demonstrated by using newest version of Leopard 2A7.

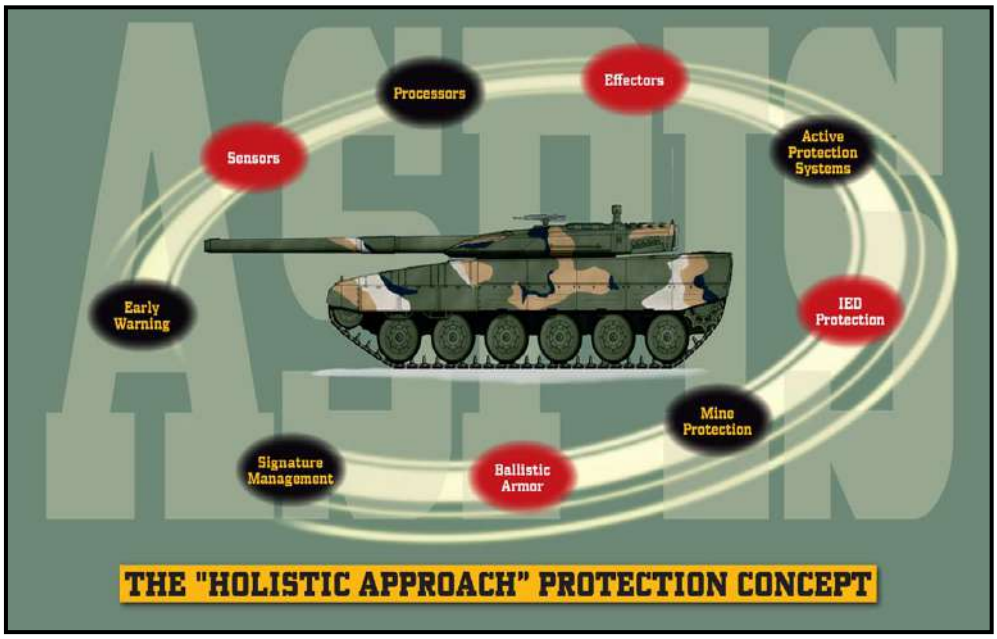

Figure 1.8: Advanced Shielding Platform Integrated System

Source: Eodh-protection (2023)

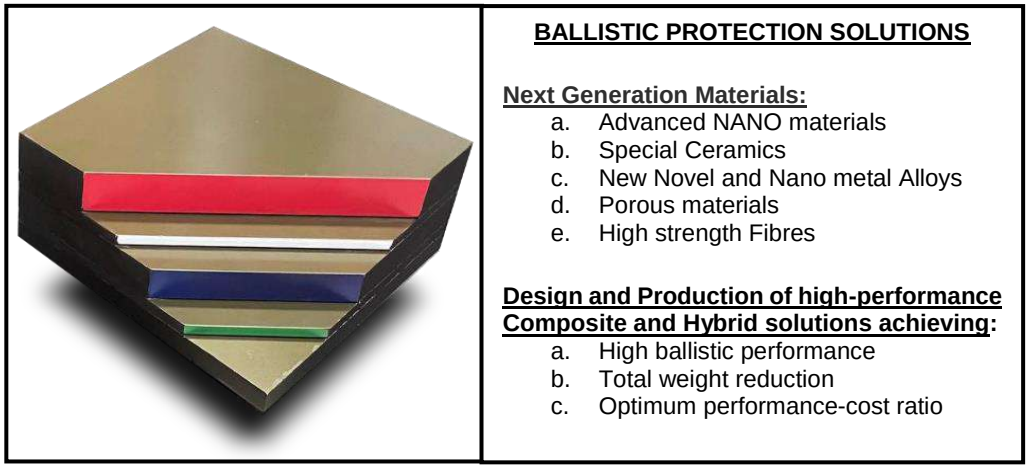

Figure 1.9: Ballistic Protection Solutions

Source: Eodh-protection (2023)

MINE AND IED PROTECTION SOLUTIONS

a. Outstanding protection performance hybrid modular solutions (NANO materials).

b. High energy absorption capabilities.

c. Low weight modules

Figure 1.10: Mine and IED Protection Solutions

Source: Eodh-protection (2023)

LINER SOLUTIONS

a. Higher ballistic performance compared to liners made from ordinary fibres.

b. Higher temperatures resistance while maintaining their strength.

c. Production of complex structural parts of vehicles with significant weight reduction.

Figure 1.11: Liner Solutions

Source: Eodh-protection (2023)

TRANSPARENT BALLISTIC SOLUTIONS

Based on innovative Glass Ceramic technology, transparent armour which offers:

a. Weight reduction up to 70%
b. Multi-hit capability
c. Visibility after multi hit attacks
d. Higher temperature resistance
e. Equivalent or better light transmission in visible and IR range
f. Delamination resistance
g. Shielding (radar, EM)

Figure 1.12: Transparent Ballistic Solutions

Source: Eodh-protection (2023)

MOLECULAR NANOTECHNOLOGY COATINGS

19. Armoured protection now has self-repairing capabilities because of molecular nanotechnology coatings, which also reduce maintenance downtime and increase operational readiness. These coatings are intended to automatically heal minor losses brought on by transit or use in warfare, offering ongoing protection without the need for expensive repairs or replacements. The coatings are able to repair minor cracks and punctures by integrating nanoparticles with regenerative characteristics, retaining the integrity of the armour and sustaining its efficacy over time (Science Advances, 2018). This development has considerably increased the overall robustness of armoured vehicles in high-intensity operating settings while simultaneously lowering lifetime costs. Here are the few examples involving AFVs:

a. **Next-Generation Armour**. The French Leclerc main battle tank has been known for its innovation. Molecular Nanotechnology Coatings have applied to its armour to provide enhanced protection against wear, impacts, and environmental factors.

b. **Reactive Coating**. The American M1 Abrams tank benefits from Molecular Nanotechnology Coatings applied as a reactive layer on its exterior. This self-repair capability would contribute to the tank's overall durability and reduce maintenance requirements.

c. **Corrosion-Resistant Coating**. The British Challenger 2 main battle tank operates in various environments, including those with high humidity. Applying Molecular Nanotechnology Coatings with superior corrosion resistance safeguards the tank's components from rust and deterioration, prolonging its service life.

d. **Nano-Diamond Coating**. The Chinese Type 99 main battle tank incorporate Molecular Nanotechnology Coatings with Nano-diamond particles. This coating would provide exceptional hardness and wear resistance, ensuring that the tank's surfaces remain intact and operational despite abrasive conditions.

e. **Advanced Anti-Reflective Coating**. Russia's T-14 Armata tank aims for advanced features. Applying an anti-reflective Molecular Nanotechnology Coating to its optics and sensor housings could reduce glare and reflections, making the tank less susceptible to detection by enemy sensors and improving its stealth capabilities.

ACTIVE PROTECTION SYSTEMS (APS)

20. This APS can broadly classify as 'Soft-Kill' and Hard-Kill'. Countermeasures that either conceal the vehicle from, or disrupt the guidance of an incoming guided missile threat are designated 'Soft-Kill' active protection measures and Countermeasures that physically strike an incoming threat to damage or destroy it and thereby limit its ability to penetrate armour are designated 'Hard-Kill' active protection measures.

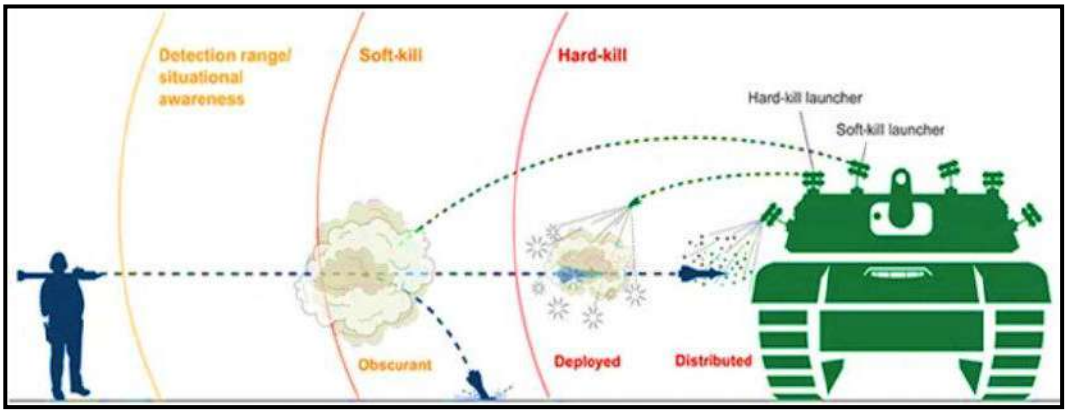

Figure 1.13: Soft Kill & Hard Kill

Source: Griswold (2019)

21. An active protection system (APS) in armoured protection refers to a technologically advanced defence mechanism integrated into armoured vehicles to enhance their survivability by actively detecting, tracking, and neutralizing incoming threats before they can cause damage to the vehicle or its occupants. APS is designed to complement the passive protection measures like armour plating by providing an additional layer of defence against modern and sophisticated threats such as anti-tank missiles, rockets, and other projectiles. These systems continually examine data from a variety of sensors, learning about and quickly adjusting to new and incoming dangers.

APS maximizes the deployment of countermeasures to neutralize incoming projectiles with maximum efficiency, leaving no opportunity for weaknesses (The Drive, 2022). This is done by pattern recognition and quick decision-making abilities. The APS changes pace with the threat environment to keep armoured vehicles extremely competent and protected from the most recent weapons and strategies.

22. **Trophy System**. The Israeli Trophy system is a widely known APS. It uses radar to detect and track incoming threats, then launches countermeasures like small interceptor rockets to destroy them before impact. This system has developed by Rafael Advanced Defence Systems Ltd. of Israel and currently fielding over 1,000 systems to all major Israeli ground combat platforms (Merkava Mark 3 & 4 and Namer APCs) and US Abrams M1A1/2, and tested on the Stryker APCs and Bradley Fighting Vehicles (BFVs). Another example is the Russian Arena-E, used in the T-90A tanks. It detects incoming threats using radar and launches projectiles to intercept and detonate the threats at a safe distance.

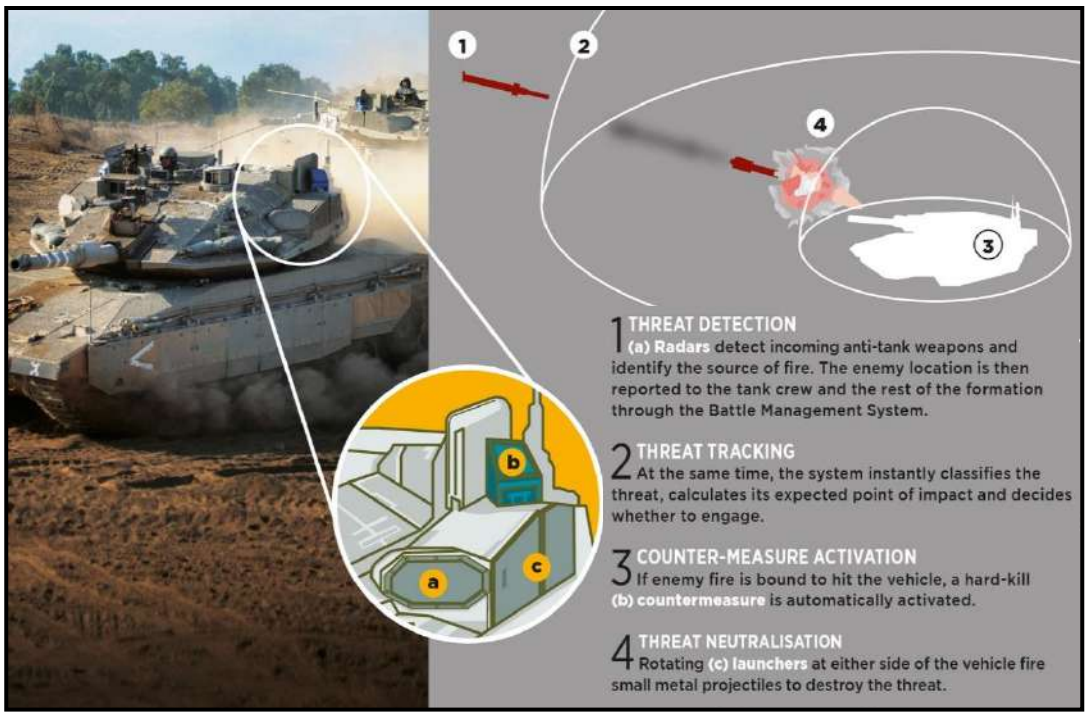

Figure 1.14: How Trophy System Work
Source: Mindef.gov.sg (2021)

23. **MUSS 2.0 – Multifunctional Self-Protection System**. This is a self-protection system for armoured vehicles in order to detect, warn and eliminate the newly emerging threats. The use of MUSS drastically reduces the probability of being hit by an anti-tank guided missile or a laser-guided weapon. A “MUSS” system comprises four warning sensors, a central unit, an IR jammer and a directional smoke launcher with control electronics. The warning sensor detects approaching missiles and laser beams directed at the vehicle. The central unit then triggers infrared measures to interfere with the missile control and/or pyrotechnical countermeasures.

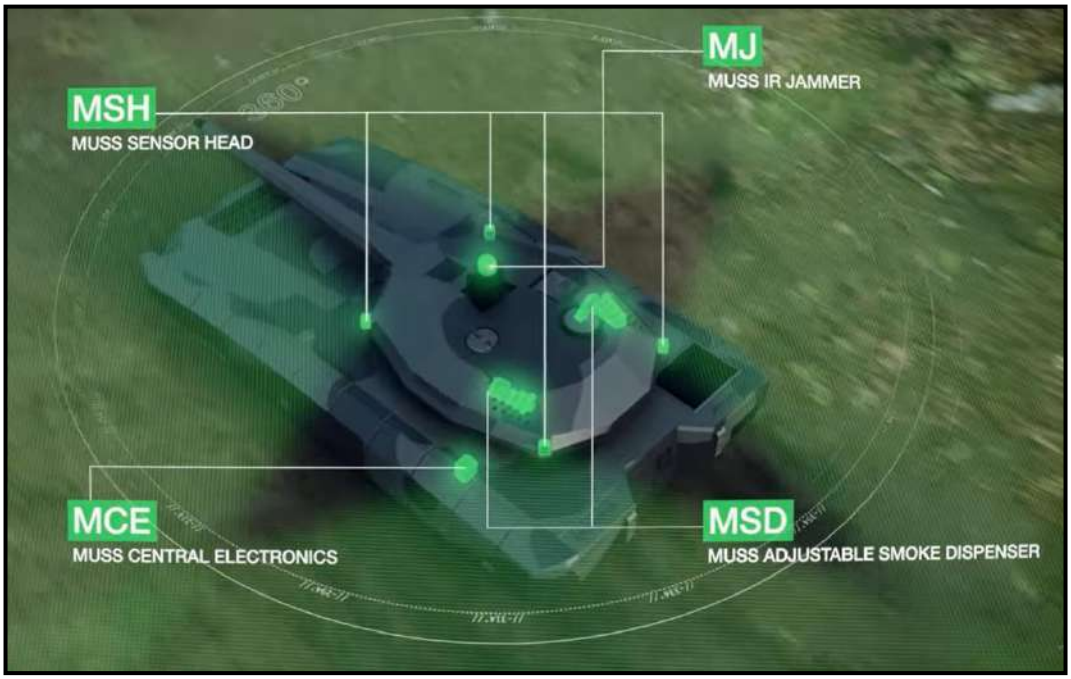

Figure 1.15: Multifunctional Self-Protection System

Source: Mindef.gov.sg (2021)

24. **Electro-Optical Vision System - SETAS (See-Through Armour System)**. The threat to tank and tank crews have increased many times in recent years. Improvised explosive devices (IEDs), modern drones and latest missiles are become the most threatening adversaries to tank protection in modern warfare (Soursesecurity, 2020). Therefore, it has spotted that improving of observation capabilities can expand the level of tank protection. SETAS is a day and night high performance local area observation system for any type of armoured vehicles, which has innovated by HENSOLDT company from Germany.

This high-resolution electro optical vision system can combine with six camera modules in one overall system, each one offering a horizontal field of view of over 90 degrees gives each crew member the possibility to stay secure under hatch without losing full visual situational awareness, 360° around the vehicle (Antal, 2022). Threats like snipers or RPG can be detected within their operating range. Particularly in urban environment this capability is a key enabler for rapid decision making and as such for platform survivability. The visual sensor is capable of the recognition of a pedestrian at a distance of some 300 metres. This observation capability can be further enhanced with the integration of other sensors, such as acoustic sniper detection sensors, laser warner system and a hemispherical camera to cover the area directly above the vehicle. greater advantage of the system can be achieved if the SETAS is connected to the vehicle's network or Battle Management System, displaying external data to each crew member individually. Using a head mounted display, crew members can virtually "see through" the armour achieving the same amount of orientation as observing when 'heads up". This system is already demonstrated by using newest version of Merkava 4 (Israel), T-14 Armata (Russia) & 'Warrior' Infantry Fighting Vehicle (British).

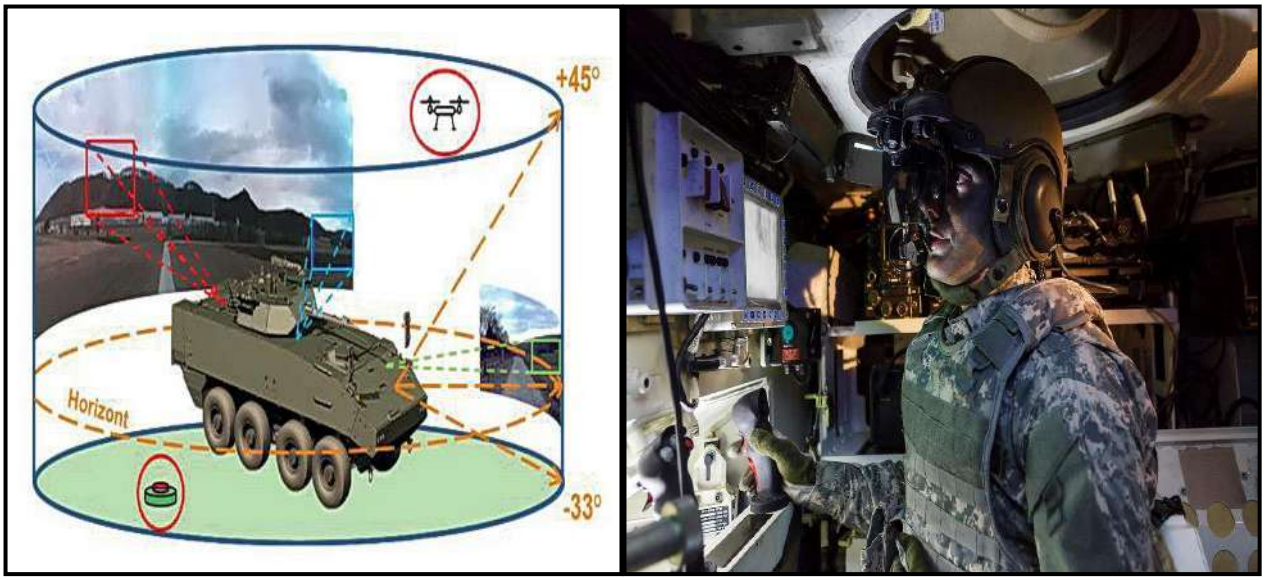

Figure 1.16: SETAS (See-Through Armour System)

Source: Nridigital.com (2022)

ADVANCEMENTS IN ARMOURED TANK MOBILITY

ELECTRIC HYBRID PROPULSION SYSTEMS

25. The use of electric hybrid propulsion technologies has significantly improved modern armoured mobility. These ground-breaking technologies, which combine conventional internal combustion engines with electric motors to transform the way armoured vehicles work, have a number of important advantages. First off, fuel economy is increased by electric hybrid propulsion systems. Electric motor integration enables the vehicle to convert to electric power when appropriate, minimizing dependency on the internal combustion engine and preserving gasoline. As a result, operating ranges are increased, allowing armoured forces to complete longer missions without needing to refuel frequently (Hollins et al., 2020). Second, the use of electric hybrid propulsion systems lowers pollution. As a result of their dependency on fossil fuels, armoured vehicles are infamous for having large carbon footprints. A more environmentally friendly approach to armoured mobility is promoted by the integration of electric components in the propulsion system, which greatly reduces the production of greenhouse gases (Vorvoreanu et al., 2018; Sokolov et al., 2019).

a. **Leopard 2 Revolution**. The Leopard 2 Revolution is a modernized version of the Leopard 2 main battle tank. It incorporates an electric hybrid propulsion system that includes an auxiliary power unit (APU) and electric drive modules.

b. **Panther KF51**. The German Panther KF51 tank employs a hybrid propulsion system as well. The electric drive assists in various situations, such as providing rapid acceleration, enhanced low-speed control, and improved fuel efficiency.

c. **Abrams-X.** The Abrams-X is a under developing armoured fighting vehicle that can be adapted for various roles, including a main battle tank. This electric drive can provide quiet operation, reduced fuel consumption, and increased agility during urban operations.

UNMANNED GROUND VEHICLES(UGVs)

26. The applications of unmanned vehicles are diverse and continue to expand as technologies advance. With the development of unmanned vehicle technologies combined with artificial intelligence (AI) has made numerous technological changes in military. In the field of armoured mobility, the use of autonomous, semi-autonomous and unmanned autonomous vehicles, offering numerous important benefits. Military unmanned vehicles can play an important role in improving the manoeuvrability, mobility, and handling performance during the operations. The unmanned combat system consists of unmanned combat platform, mission load, and command and control system. Unmanned combat platform is an important part of an unmanned combat system, which can replace soldiers to complete special dangerous military tasks under various extreme conditions, such as replacing combat soldiers in the harsh combat environment to effectively complete the acquisition of intelligence, surveillance, reconnaissance, fire attack, transportation, search and rescue, mine clearance, protection of combat soldiers safely leaving the field and other important tasks(Wang et al., 2021). UGVs come in different configurations that are suitable for different types of terrain and tasks. For applications that require the vehicle to move over uneven and rough terrain, several configurations should be considered, with wheels or tracks. Unmanned vehicles have been increasingly explored in recent years due to their versatility and ability to access hard-to-reach areas.

27. The biggest feature of the ground unmanned combat platform is that it can carry certain weapons and equipment under the premise of unmanned participation, and be remotely controlled through the configured wireless communication equipment to conduct reconnaissance, surveillance, electronic interference, and direct combat. It has many advantages such as high degree of automation, good remote control, strong digital communication ability and anti-interference, excellent target detection and recognition ability, good concealment, and strong adaptability to the ground environment.

Figure 1.17: The Type-X Combat Vehicle

Source: Milrem (2022)

Figure 1.18: ROBUST - Israeli Medium Robotic Combat Vehicle

Source: Elbit Systems (2022)

Figure 1.19: RIPSAW M5

Source: Textronsystems (2023)

URBAN MOBILITY AND CLIMBING CAPABILITIES

28. Military vehicles, both wheeled and tracked platforms, have to overcome different terrain conditions such as soft soil, cross country, snow area along with variety of natural and man-made obstacles. Therefore, the necessity for armoured vehicles with improved mobility and climbing skills has been spurred by the changing nature of combat, particularly in urban settings. Urban warfare necessitates the capacity to manoeuvre across intricate cityscapes, overcome challenges, and offer tactical benefits in close-quarters combat situations. Armoured vehicles with improved agility can easily pass through busy metropolitan areas and small streets (Bunker et al., 2019). In urban combat, where opponents frequently take advantage of high locations and roofs, climbing skills are especially essential. Armoured vehicles with climbing capabilities can get through barricades, rubble, and other obstructions, giving troops more mobility and adaptability (Banks et al., 2020). The world advanced tank has reached a higher level, such as the German Leopard 2A7+ tanks and Japanese type TK10 main battle tank, the cross-country average speed reached 55km/h. The French LeClair MBT cross-country average speed of 50 km/h and a new generation of Russian MBT maximum road speed of more than 85km/h, the Belarus 2T tank cross-country average the rate of 60km/h, the maximum road speed reached 95km/h (Guoying et al., 2022)

a. **Independent Suspension Systems**. The suspension systems used in vehicles can be divided into three main variants; Passive suspensions, Semi-active suspensions and Active suspensions. Tanks are now being equipped with advanced independent suspension systems that allow each wheel to move independently. This enables better traction, stability, and manoeuvrability in urban environments, where navigating tight corners and uneven surfaces is crucial.

b. **Electric Drive Systems**. Electric propulsion systems provide precise control over each track or wheel, enabling tanks to make rapid turns and navigate confined urban spaces more effectively. Electric drive systems also offer quieter operation, which can be advantageous for stealthy urban operations.

c. **Adaptive Tracks**. Tanks are incorporating adaptive track systems that automatically adjust the track's width and configuration based on the terrain. These tracks provide improved traction while climbing over obstacles or manoeuvring through challenging urban landscapes.

d. **Terrain Scanning and Mapping**. Tanks can use sensors and Lidar technology to scan and map the terrain ahead. This information helps the tank's computer systems plan optimal paths for climbing and obstacle negotiation, ensuring safe and efficient manoeuvres.

ARTIFICIAL SWARM INTELLIGENCE FOR ARMOURED UNITS

29. Swarm intelligence (SI) is the collective behaviour of decentralised, self-organised systems, which can be natural or artificial. Moreover, Artificial Swarm Intelligence (ASI) is a process of amplifying the collective intelligence of networked users in real time data integrated with AI. Moreover, armoured mobility has been transformed by the use of AI-driven swarm intelligence, which has also changed how armoured forces function on the battlefield. Autonomous armoured vehicles can manoeuvre and react with remarkable agility and flexibility in combat scenarios by using real-time communication and AI algorithms. A collection of autonomous armoured vehicles may work together as a seamless unit, sharing information, and collaborating thanks to swarm intelligence. This capacity is especially useful in combat situations that are dynamic and complicated, where split-second judgments might mean the difference between success and defeat (Adams et al., 2022). Also, there are five variables to be essential for success of a swarm attack. Those are superior situational awareness, elusiveness, standoff capability, encirclement and simultaneity. AI algorithms enable the swarm to draw lessons from the past and modify their strategies accordingly. The armoured units are more resistant to changing threats and unforeseen circumstances due to their adaptable character, which also ensures that they can successfully address new difficulties on the battlefield (Muir et al., 2023).

30. **MGCS (Main Ground Combat System) – The Smart Tank.** This programme means deployment of key technologies, including a decision-centric battle management solution to achieve great mobility and situational awareness through information and AI technologies. After all, the intelligent fusion of data from different sources not only grants an information advantage but also decision-making superiority. The ability to make faster and more purposeful decisions in other words, to issue commands and initiate action also considerably improves the likelihood of mission success. This is especially the case when such detailed situational overviews need to be exchanged between vehicles and troops. In this system, all information captured by the devices and sensors in use has to be merged and evaluated in real time with the aid of data analysis, pattern recognition and machine learning algorithms. Only then it will be possible to provide the MGCS crew with a comprehensive overview of the situation and recommendations for action. This is called, Distributed Sensor Data Fusion, which is a key enabler and contributor to the Combat Cloud. It means that all information can be accessed by all vehicles at all times. The crew receives the data from all connected vehicles at that time. While multi-mission radars monitor tracts of up to many kilometres, a careful eye can be kept on the area at close range around a vehicle using the 360° panoramic view to achieve maximum mobility with communication. Unmanned Aerial Vehicles (UAVs), laser rangefinders, friend-or-foe identification systems and jammers are integrated into MGCS. It is set to replace the current Leopard 2 and Leclerc main battle tanks. Followings can achieve through the MGCS;

a. **Swarm Coordination and Adaptive Manoeuvres.** Tanks equipped with advanced communication systems and sensors can operate in a coordinated manner, mimicking the behaviours of a swarm. For instance, they can share real-time information about obstacles, routes, and threats, allowing them to adapt their movements collectively.

b. **Adaptive Obstacle Negotiation.** Tanks can use swarm intelligence principles to optimize their obstacle negotiation. When encountering challenging terrain or obstacles, tanks can analyse their collective capabilities and decide which tank is best suited to lead the way. The others can then follow suit, adjusting their movements based on the leader's actions.

c. **Adaptive Threat Response.** Tanks equipped with advanced sensors, such as the T-90 and Abrams, can employ Swarm Intelligence to respond to threats. When one tank detects an enemy position, it shares this information with the others.

d. **Decoy and Diversions**. Swarm Intelligence systems could facilitate tactical diversions and decoy manoeuvres. Tanks could work together to create distractions, confuse enemies, or redirect attention away from critical areas.

Figure 1.20: Information generated by sensors within one single system
Source: Armyrecognition.com (2022)

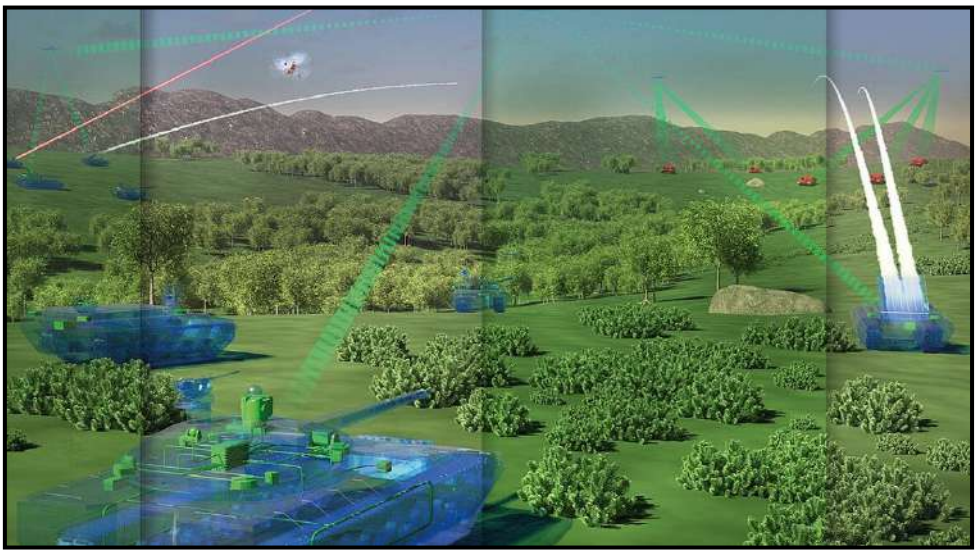

Figure 1.21: Swarm Coordination and Adaptive Manoeuvres
Source: Hensoldt.net (2022)

CONCLUSION

31. Armoured vehicles occupy a pivotal role within modern military paradigms, poised at the nexus of safeguarding personnel and material assets while conferring strategic versatility. As improved defensive capabilities, these developments incorporate reactive armour, composite ceramic plates, and Active Protection Systems (APS). Modern advancements in armoured protection include electromagnetic armour, molecular nanotechnology coatings, electro-optical reactive armour (EORA), next-generation composite materials, and Adaptive Active Protection Systems (A-APS). These innovations provide protection systems that are self-healing and AI-driven. Electric hybrid propulsion systems, semi-autonomous convoy operations, urban mobility and climbing capabilities, and AI-driven swarm intelligence have all contributed to improved armoured mobility. These developments enable armoured vehicles to operate in many terrains, lessen their negative environmental effect, and improve their capacity to move and operate together in challenging combat situations.

32. The aforementioned progressions collectively initiate a pivotal transformation in the dynamics of armoured vehicles, ushering forth an era-defining alteration. This transformation serves as a catalyst for the facilitation of methodically enhanced deployment strategies across an array of diverse terrains. Concurrently, these advancements led to enhance tactical effectiveness and prominently uplifting the strength of armoured vehicles within the complex theatre of combat scenarios.

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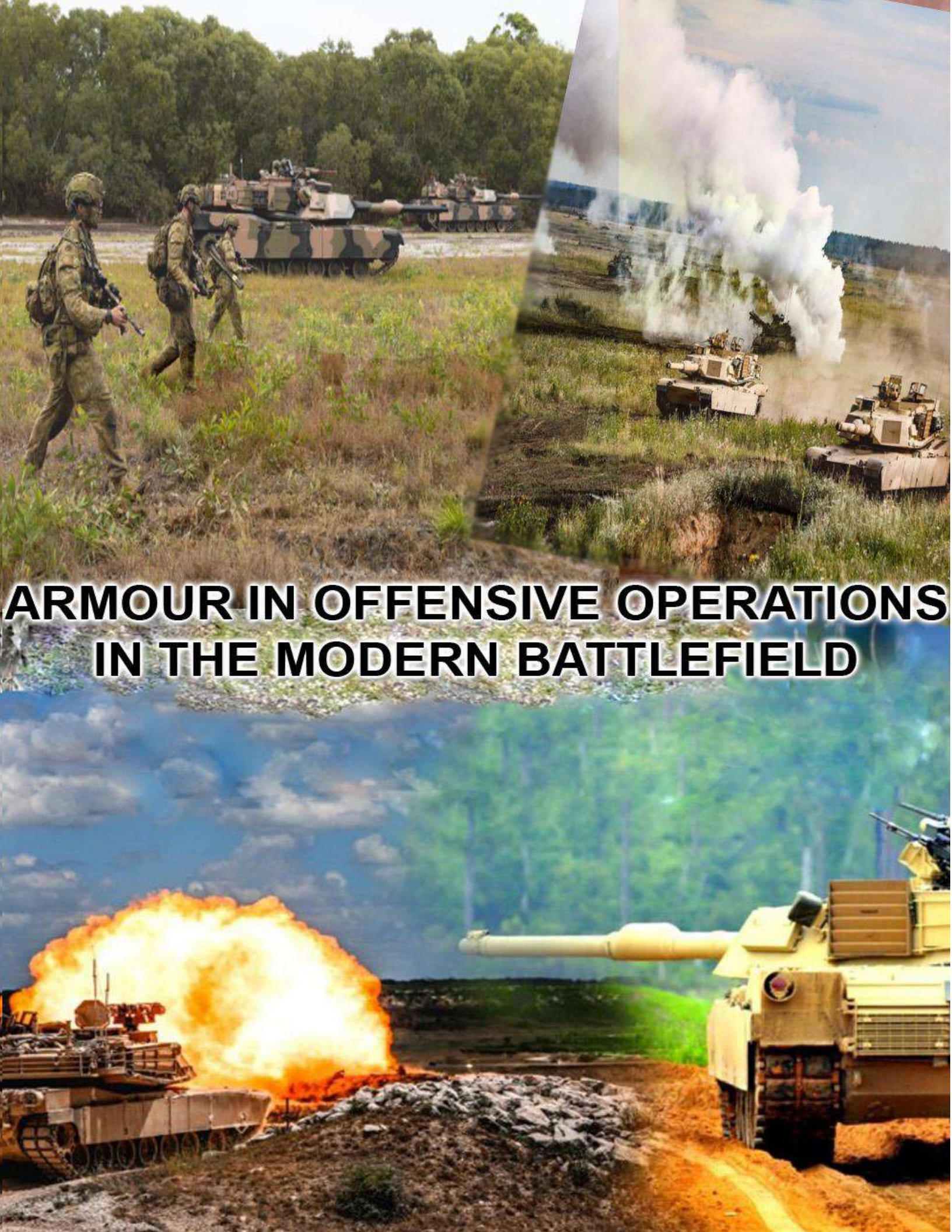
SESSION TWO

MODERN TRENDS IN ARMOUR TACTICS



ARMOUR IN OFFENSIVE OPERATIONS IN THE MODERN BATTLEFIELD

ARMOUR IN OFFENSIVE OPERATIONS IN THE MODERN BATTLEFIELD

by

Lt Col IAB Kulatunga psc

ABSTRACT

This academic paper provides a comprehensive analysis of the tactical perspective on the utilization of armour in offensive operations. The paper begins by discussing the historical context and importance of armour in offensive warfare. It highlights the significance of armour and its role in shaping battlefield outcomes. The paper then explores the integration of armoured units with other combat arms. It emphasizes the importance of the combined arms approach and highlights the role of armoured infantry support and fire support coordination in maximizing the effectiveness of armour in offensive operations. Furthermore, the paper delves into the specific utilization of armour in offensive operations. It examines the crucial aspects of manoeuvrability, mobility, protection, firepower, and the psychological impact of armour on adversaries. It underscores the considerable advantages that armour brings to offensive operations. The paper also addresses logistical considerations related to armoured operations. It emphasizes the need for effective fuel and ammunition resupply, maintenance, and robust command and control systems to ensure continuous and effective armour operations. To provide practical insights, the paper presents notable case studies, including Operation Desert Storm and Battle of 73 Easting, the Iraq War, the conflict in Ukraine, the Syrian War, and the experience of Israel and Sri Lanka in fighting against irregular adversaries. These case studies offer valuable lessons and highlight successful implementation of armour in offensive operations. Furthermore, the paper discusses advancements in armour technology. It examines the integration of autonomous and unmanned systems, survivability innovations, and weapon systems integration. These advancements have significantly enhanced the capabilities of armour and have the potential to revolutionize offensive operations. The paper also addresses contemporary challenges faced by armour, including anti-armour threats, hybrid warfare, and the role of armoured forces in urban warfare. It underscores the importance of adapting to these challenges to ensure the effective utilization of armour in offensive operations. In conclusion, this paper summarizes the key findings and offers recommendations for future operations.

It emphasizes the need for military strategists to adopt an integrated and adaptable approach to harness the full potential of armour in offensive operations on the modern battlefield. The paper urges policymakers and military leaders to consider the insights and recommendations provided to enhance the effectiveness of armour in offensive operations.

INTRODUCTION

1. The effective utilization of armoured forces is crucial in achieving success in offensive warfare. Armour, or armoured vehicles, plays a vital role in offensive operations on the modern battlefield. With their combination of firepower, protection, and mobility, armoured units are instrumental in penetrating enemy lines, neutralizing enemy positions, and seizing key objectives (Bazley, 2012; Carpenter, 2004).

2. However, in order to fully utilize the capabilities of armoured forces, a comprehensive and integrated approach is necessary. This paper aims to provide a comprehensive analysis of the tactical perspective on the utilization of armour in offensive operations. By examining historical examples and contemporary warfare concepts, it seeks to highlight the importance of armour and emphasize the need for a comprehensive and integrated approach to harnessing their full potential (Biddiscombe, 2003; Department of Defence, 2019).

3. By examining historical examples, such as the Battle of Kursk during World War II or the Battle of 73 Easting in the Gulf War, we can gain valuable insights into the impact of armour in offensive operations. These examples demonstrate the decisive role that armoured units have played throughout history and serve as reminders of the strategic and tactical advantages they can provide (Biddiscombe, 2003; Carpenter, 2004; Linn, 2007).

4. Furthermore, by exploring contemporary warfare concepts, such as the combined arms approach, we can understand how armoured forces can work in harmony with other combat arms to maximize their effectiveness. The combined arms approach recognizes that no single component can achieve success on its own and emphasizes the integration of infantry, artillery, air support, and other assets to achieve operational objectives (Department of Defence, 2019; Sharp, 2014).

5. Within this framework, armoured units serve as the backbone, providing the necessary firepower and mobility to drive the offensive operations forward (Carpenter, 2004). Additionally, this paper will delve into the specific ways in which armoured units can be utilized in offensive operations. This includes their manoeuvrability and mobility, which enable them to exploit gaps in enemy lines and conduct rapid advances. The protection and firepower provided by armoured vehicles are crucial for breaching enemy Defences and neutralizing enemy positions (Gavilan, 2018; Lengel, 2007).

6. Furthermore, the shock and psychological effects of armoured operations cannot be underestimated. The sheer presence of armoured vehicles instils fear and disruption among enemy forces, often leading to demoralization and the breakdown of enemy command and control structures (Carpenter, 2004; Linn, 2007).

7. In order to achieve success in offensive operations, logistical considerations must also be considered. Effective fuel and ammunition resupply, maintenance and repair, and robust command and control systems are essential for sustaining operational readiness. This paper will explore the logistical challenges and considerations related to armoured operations, highlighting the importance of efficient resupply systems, rapid repair capabilities, and secure communication networks (Perera, 2015; Sharp, 2014).

8. To provide practical insights into the successful implementation of armour in offensive operations, notable case studies will be presented. These case studies will encompass a range of contexts, including conventional warfare scenarios such as the Gulf War and the Iraq War, as well as conflicts against irregular adversaries like those faced by Israel and Sri Lanka. By analysing these case studies, we can gain valuable lessons learned and best practices that can inform future operations (Lengel, 2007; Perera, 2015).

9. Furthermore, this paper will discuss advancements in armour technology, such as autonomous and unmanned systems, as well as armour survivability innovations and weapon systems integration. These advancements have the potential to revolutionize offensive operations and further enhance the capabilities of armoured forces on the modern battlefield (Steinbrink, 2016).

10. However, as with any aspect of warfare, there are contemporary challenges that must be addressed. This paper will examine anti-armour threats, such as modern anti-tank guided missiles, as well as the implications of hybrid warfare and asymmetrical threats on the utilization of armour in offensive operations (Truffleman, 2011). Additionally, the role of armoured forces in urban warfare, where the environment poses unique challenges, will also be considered (Gavilan, 2018).

11. In conclusion, this paper seeks to provide a comprehensive analysis of the tactical perspective on the utilization of armour in offensive operations. By examining historical examples, exploring contemporary warfare concepts, discussing logistical considerations, presenting case studies, and addressing advancements and challenges, it aims to equip military strategists with the knowledge and insights necessary for effective offensive operations. The integrated and adaptable approach advocated in this paper will enable the harnessing of the full potential of armour on the modern battlefield.

BACKGROUND OF THE STUDY

12. Background Throughout history, armoured units have been at the forefront of military innovation, providing a formidable advantage on the battlefield. Dating back to ancient civilizations, such as the Egyptians and Assyrians, armies recognized the benefits of armoured vehicles in offensive operations (Bazley, 2012).

13. The introduction of chariots revolutionized warfare, providing enhanced mobility, protection, and striking power. As warfare evolved, so did the armoured vehicles. During the medieval period, knights clad in heavy armour dominated the battlefield. Their armoured steeds and protective coverings allowed them to charge into the enemy ranks with unparalleled force (Bazley, 2012).

14. The advent of firearms gradually rendered traditional armour obsolete, paving the way for the development of new types of armoured vehicles. The true potential of armoured vehicles was realized during World War I with the introduction of tanks. These lumbering beasts of steel brought a new level of firepower and mobility to the battlefield.

Tanks like the British Mark I and German A7V became symbols of military innovation and were key to achieving offensive breakthroughs on the Western Front (Bazley, 2012; Biddiscombe, 2003). The significance of armour in offensive operations became even more pronounced during World War II. The German blitzkrieg tactics, employing highly mobile and heavily armoured Panzer divisions, allowed for lightning-fast advances and operational successes. The coordination of armoured units with air support and infantry ensured their effectiveness and highlighted the importance of combined arms operations (Biddiscombe, 2003; Carpenter, 2004).

15. The arms race of the Cold War era led to significant advancements in armoured vehicle technology. Tanks like the American M1 Abrams and the Soviet T-72 became the symbols of modern armoured warfare. These vehicles incorporated advanced armour protection, powerful main guns, and sophisticated targeting systems, all aimed at enhancing the offensive capabilities of armoured units (Sharp, 2014).

16. Analysing the historical context of armoured vehicles allows us to understand their significance in offensive operations and provides valuable insights for strategic and tactical planning. The lessons learned from past conflicts highlight the importance of innovation, combined arms coordination, and adaptability to meet the challenges of an ever-changing battlefield. As military strategists and commanders seek to optimize the utilization of armoured forces in offensive operations, understanding the historical evolution of armoured vehicles becomes paramount (Bazley, 2012; Carpenter, 2004; Sharp, 2014).

OBJECTIVES OF THE STUDY

17. The objective of this paper is to provide a comprehensive analysis of the tactical perspective on the utilization of armour in offensive operations. It aims to equip military strategists with the knowledge and insights necessary to effectively harness the capabilities of armoured units in offensive warfare. To achieve this objective, the paper will delve into various aspects related to the utilization of armour in offensive operations (Bazley, 2012).

18. It will explore the capabilities and limitations of armoured units, shedding light on their strengths and vulnerabilities. By understanding these factors, military strategists can make informed decisions regarding the employment of armoured forces in offensive operations (Bazley, 2012).

19. Furthermore, the paper will examine the integration of armour with other combat arms, emphasizing the importance of a combined arms approach. The effective coordination of infantry, artillery, air support, and other assets is essential for maximizing the offensive capabilities of armour. By analysing the integration of armoured units with other combat arms, the paper will provide insights into how different components can complement each other to achieve operational objectives (Department of Defence, 2019).

20. In addition, the paper will analyse specific ways of utilizing armour in offensive operations. It will explore the manoeuvrability and mobility of armoured units, highlighting their ability to exploit gaps in enemy Defences and conduct rapid advances. The protection and firepower provided by armour will also be examined, demonstrating their role in breaching enemy positions and neutralizing threats. Moreover, the psychological impact of armoured operations, including the shock they inflict on enemy forces, will be explored (Carpenter, 2004; Gavilan, 2018).

21. Logistical considerations play a critical role in the effective utilization of armoured forces. Therefore, the paper will examine the logistical challenges and considerations related to armour in offensive operations. It will emphasize the importance of efficient fuel and ammunition resupply, timely maintenance and repair, and robust command and control systems. By addressing these logistical factors, military strategists can ensure the sustained operational readiness of armoured forces (Perera, 2015; Sharp, 2014).

22. To provide practical insights, the paper will present notable case studies. These case studies will encompass a range of contexts, including conventional warfare scenarios like the Gulf War and the Iraq War, as well as conflicts against irregular adversaries such as those faced by Israel and Sri Lanka. By analysing these case studies, the paper will highlight successful implementation strategies and lessons learned (Lengel, 2007; Perera, 2015).

23. Furthermore, the paper will discuss advancements in armour technology. It will explore the potential of autonomous and unmanned systems, the latest innovations in armour survivability, and the integration of advanced weapon systems. Understanding these advancements will allow military strategists to incorporate cutting-edge technology into offensive operations and leverage the advantages they offer (Steinbrink, 2016).

24. Lastly, the paper will address contemporary challenges in the utilization of armour in offensive operations. It will analyse anti-armour threats, such as modern anti-tank guided missiles, and the implications of hybrid warfare and asymmetrical threats. Additionally, the role of armoured forces in urban warfare, where the environment poses unique challenges, will be examined (Gavilan, 2018; Truffleman, 2011).

25. By examining these various aspects, the paper aims to provide a comprehensive analysis of the tactical perspective on the utilization of armour in offensive operations. The knowledge and insights gained.

ROLE OF ARMOUR IN OFFENSIVE OPERATIONS

HISTORICAL CONTEXT

26. A thorough understanding of the historical context of armour is essential to comprehend its importance in offensive operations. Throughout history, pivotal battles have showcased the effectiveness of armour in achieving tactical success. One such remarkable battle that highlighted the power of armour was the Battle of Kadesh in 1274 BCE (Carney, 2021). This battle, fought between the Egyptian Empire and the Hittite Empire, witnessed the deployment of chariots, which were considered a form of early armour. Both sides fielded large numbers of chariots, and their strategic use played a critical role in the outcome of the battle. The chariots allowed for swift movement and provided the soldiers with added protection on the battlefield. This battle showcases how armoured vehicles can be decisive factors in determining the outcome of offensive operations.

27. In more recent history, the significance of armour in offensive operations became evident during World War I. The Battle of Cambrai in 1917 provides a noteworthy example (Horne, 2002). This battle saw the widespread use of tanks, which were a novel addition to the battlefield. The British launched a surprise attack with an unprecedented number of tanks, overwhelming the enemy Defences and creating a breakthrough. This demonstrated the potential of armoured vehicles to breach enemy lines and catalyse offensive momentum.

28. Another notable historical example is the Battle of Kursk during World War II. The German and Soviet forces engaged in a massive armoured confrontation, with both sides deploying vast numbers of tanks. This battle showcased the importance of armour as a force multiplier in offensive operations (Zamulin, 2015). It demonstrated the significance of armoured superiority and highlighted the need for effective coordination with infantry and air support for overall success. By analysing historical battles, we gain valuable insights into the role of armour in offensive warfare. These battles underscore the decisive impact that armoured units can have on the battlefield. They demonstrate the importance of armoured vehicles in achieving offensive breakthroughs, neutralizing enemy positions, and securing key objectives. The strategic use of armour, whether in the form of chariots, tanks, or other armoured vehicles, has consistently played a critical role in offensive operations throughout history. Understanding the historical context of armour allows us to appreciate its enduring significance in offensive warfare. By learning from the successes and failures of past conflicts, military strategists can shape effective doctrines, develop sound tactics, and capitalize on the advancements in armour technology to maximize the offensive capabilities of armoured units on the modern battlefield.

IMPORTANCE OF ARMOUR

29. Armour provides numerous strategic and tactical advantages on the battlefield, making it a crucial asset in offensive operations. The significance of armour stems from its mobility, protection, and firepower capabilities. One of the key advantages of armour is its mobility and manoeuvrability. Armoured vehicles, with their powerful engines and rugged suspension systems, can traverse challenging terrain and maintain high speeds. This mobility enables armoured units to conduct rapid advances, flank enemy positions, and encircle the enemy, creating strategic dilemmas for the opposing forces (Department of the Army, 1991).

By exploiting weak points and outflanking the enemy, armoured units can disrupt enemy Defences and effectively penetrate their lines. This manoeuvrability gives armoured forces the flexibility to adapt to changing battlefield conditions and sustain offensive momentum.

30. Furthermore, the protective capabilities of armour contribute significantly to the success of offensive operations. Armoured vehicles are designed to withstand enemy fire and provide a shield for troops within them. The combination of heavy armour plating, reinforced hulls, and built-in defensive systems such as reactive armour or composite materials provides significant protection against small arms fire, shrapnel, and even some anti-tank weaponry. This protective shield enhances the survivability of troops, allowing them to advance and execute offensive actions under enemy fire. The psychological impact of facing heavily armoured vehicles can also have a demoralizing effect on the enemy, giving armoured forces an additional advantage in offensive operations.

31. Additionally, the firepower of armoured vehicles is a critical factor in offensive operations. Tanks and other armoured vehicles are equipped with formidable weaponry, including high-velocity cannons, advanced missile systems, and secondary armaments such as machine guns. This firepower enables armoured forces to suppress and destroy enemy positions, neutralizing threats to friendly forces and creating pathways for further advances. The ability to engage targets at long range, coupled with the accuracy and lethality of the weapon systems, provides armoured units with a significant advantage in offensive operations. The combination of firepower, mobility, and protection enables armoured units to dominate the battlefield and dictate the tempo of offensive actions.

32. In conclusion, the importance of armour in offensive operations cannot be overstated. Its mobility and manoeuvrability allow for rapid advances and the exploitation of weak points in enemy Defences. The protective capabilities of armour enhance survivability and enable offensive actions in hostile environments. The firepower of armoured vehicles provides the ability to suppress and destroy enemy positions, granting ground forces the advantage they need to achieve success in offensive operations. By leveraging these strategic and tactical advantages, armoured units play a crucial role in offensive operations, contributing to the overall success of military campaigns.

CAPABILITIES AND LIMITATIONS

33. While armour boasts formidable capabilities, it is not without limitations. Recognizing and understanding these capabilities and limitations is essential for military planners and strategists to develop tactics and strategies that effectively exploit the strengths of armour while mitigating its vulnerabilities. One significant limitation of armour is its vulnerability to anti-armour threats. Advancements in anti-tank guided missiles (ATGMs) and other anti-armour weaponry pose a significant challenge to armoured units. These weapons can penetrate even the thickest armour and pose a serious threat to armoured vehicles. Additionally, the widespread use of improvised explosive devices (IEDs) and roadside bombs further increases the risk to armoured units. These asymmetric threats can immobilize or destroy armoured vehicles, significantly hampering offensive operations. Understanding these anti-armour threats is crucial for planning and implementing countermeasures to neutralize or mitigate their impact.

34. Despite these limitations, armour also possesses notable capabilities that give it a significant advantage on the battlefield. The mobility and manoeuvrability of armoured units enable rapid advances, supporting the exploitation of enemy weaknesses and the execution of flanking manoeuvres (Department of the Army, 1991). The combination of innovative suspension systems, engine power, and advanced autonomous technologies allows armoured vehicles to traverse a wide range of terrains with speed and agility. This mobility enables armoured units to quickly gain favourable positions, maintain offensive momentum, and respond to changing battlefield conditions.

35. The protective capabilities of armour, although not impenetrable, provide a crucial advantage in offensive operations. The combination of advanced armour plating, reactive armour, and other defensive systems can withstand a range of battlefield threats, including direct fire from small arms, artillery shells, and even some anti-tank missiles. The protection offered by armoured vehicles allows troops to manoeuvre in hostile environments with increased safety, enhancing offensive operations.

36. In terms of firepower, armoured units possess potent weapon systems that can suppress and destroy enemy positions. Their main guns, often equipped with advanced targeting systems and ammunition options, deliver accurate and lethal firepower against a variety of targets. Additionally, secondary armaments such as machine guns provide effective close-range Defence and support. The combination of firepower and protection enables armoured units to dominate the battlefield and exert significant influence over offensive operations.

37. However, it is crucial to recognize that armour's capabilities can be compromised if not properly supported. The complexity and maintenance requirements of armoured vehicles necessitate effective logistical support. Adequate fuel and ammunition resupply, as well as maintenance and repair capabilities, are crucial for sustaining the operational readiness of armoured units. Moreover, robust command and control systems are necessary to coordinate the integration of armoured forces with other combat arms and maximize their effectiveness in offensive operations.

38. By delving into the specific capabilities and limitations of armour, this paper provides military planners and strategists with a comprehensive understanding of armour's role in offensive operations. Armed with this knowledge, they can develop tactics, strategies, and countermeasures that leverage the strengths of armour while addressing its vulnerabilities. This holistic approach allows for the effective utilization of armoured forces and the optimization of their contribution to successful offensive operations on the modern battlefield.

INTEGRATION OF ARMOUR WITH OTHER COMBAT ARMS

COMBINED ARMS APPROACH

39. To maximize the effectiveness of armoured forces in offensive operations, it is crucial to adopt a combined arms approach (Department of the Army, 2017). This approach involves the integration and coordination of various combat arms, including infantry, artillery, and other supporting units. By combining the strengths and capabilities of different units, the combined arms approach creates a synergistic effect that amplifies the overall combat power on the battlefield.

40. In offensive operations, the role of armour within the combined arms framework is paramount (Department of the Army, 2017). Armoured units provide mobility, protection, and firepower, which are essential for achieving success. They possess the capability to rapidly exploit breakthroughs, conduct deep penetrations into enemy territory, and perform flanking manoeuvres. However, the true potential of armoured forces can only be realized when they are integrated seamlessly with other combat arms.

41. Infantry plays a vital role in supporting armoured forces (Department of the Army, 2017). They can secure and hold ground, clear enemy positions, and conduct close combat operations. Infantry units are able to move through difficult terrains where armoured vehicles may have limited mobility, and their ability to engage in close-quarters combat complements the versatile capabilities of armoured units. The coordination between armoured and infantry units, known as armoured infantry support, is critical for achieving success on the battlefield. Close coordination is vital to ensure that infantry units are adequately protected and can effectively engage enemy positions while advancing alongside armoured units.

42. Artillery support is another key component of the combined arms approach (Department of the Army, 2017). Artillery units provide fire support to neutralize enemy defences and suppress hostile positions. They can also conduct counter-battery fire to neutralize enemy artillery and disrupt their operations. Robust coordination between armoured units and artillery is essential to ensure effective fire support. This coordination entails precise target selection, communication, and synchronization of attacks to maximize the impact on the enemy.

43. The integration of other combat arms, such as engineers, air support, and intelligence units, further enhances the effectiveness of armoured forces in offensive operations (Department of the Army, 2017). Engineers can assist in breaching enemy obstacles, constructing bridges, and improving mobility for armoured units. Air support can provide close air support for ground forces, conducting airstrikes on enemy positions, and disrupting enemy lines of communication. Intelligence units provide crucial information, enabling armoured forces to identify enemy positions, anticipate enemy movements, and make informed decisions.

44. The combined arms approach recognizes that individual combat arms have their own strengths and weaknesses. By integrating these arms, operational limitations can be overcome, and the full potential of each unit can be harnessed (Department of the Army, 2017). Effective integration requires thorough planning, clear communication, and continuous coordination among units. It also necessitates a shared understanding of the overall mission and objectives, as well as trust and confidence in the abilities of each unit.

45. Overall, the combined arms approach highlights the importance of integrating armour with other combat arms in offensive operations (Department of the Army, 2017). By combining the mobility, protection, and firepower of armoured units with the capabilities of infantry, artillery, and other supporting units, the combined arms approach maximizes the combat effectiveness of the entire force. This integration results in a synergistic effect that increases the chances of success on the battlefield and enables the exploitation of opportunities for victory.

ARMOURED INFANTRY SUPPORT

46. Infantry support is essential for armoured units to achieve success in offensive operations (Department of the Army, 2017). The integration of armoured and infantry units is crucial for maximizing the combat effectiveness of both. Armoured infantry support plays a vital role in providing additional firepower, situational awareness, and close-quarters combat capabilities on the battlefield.

47. One of the primary reasons why armoured infantry support is important is its ability to secure and hold ground that is gained by armoured units (Department of the Army, 2017). Armoured forces, while highly mobile, may not have the capability to occupy and defend territory for an extended period. Infantry units, on the other hand, are trained for dismounted operations and possess the skills and equipment necessary for holding and defending ground against hostile forces. By working in conjunction, armoured and infantry units can ensure the successful consolidation and exploitation of gains made during offensive operations.

48. Armoured infantry support also provides additional firepower to armoured units (Department of the Army, 2017). While armoured vehicles possess significant firepower, they may not have the same level of precision and flexibility as infantry units when engaging enemy positions in close proximity. Infantry units are trained to navigate and fight in complex terrain and can effectively engage hostile forces in buildings, dense vegetation, and other challenging environments. By working in tandem, armoured units can rely on the infantry's expertise in close-quarters combat to neutralize enemy defensive positions and increase the overall firepower of the combined force.

49. Coordination between armoured and infantry units is paramount for effective cooperation and mutual support on the battlefield (Department of the Army, 2017). Communication and shared situational awareness are vital to avoid friendly fire incidents and confusion. The establishment of clear lines of communication and the use of standardized procedures ensure the seamless integration of armoured and infantry units. Regular training exercises and joint operations can help in fostering cohesion and familiarity between the two units, enabling them to work together more efficiently.

50. In addition to coordination and communication, there is a need for joint planning and rehearsals to develop tactics, techniques, and procedures (TTPs) that maximize the synergy between armoured and infantry units (Department of the Army, 2017). This includes identifying the roles and responsibilities of each unit, determining the best method of deployment and employment of forces, and establishing contingency plans. Joint training exercises, where armoured and infantry units practice operating together, can also enhance their ability to work as a cohesive force.

51. The integration of armoured and infantry units is not just limited to combat operations but extends to various other tasks as well. Armoured units often rely on infantry support for security during halts, establishing defensive positions, conducting offensive patrolling, and conducting search and clearance operations (Department of the Army, 2017). Additionally, infantry units can assist in providing additional eyes and ears on the battlefield, enhancing the overall situational awareness of the combined force.

52. In summary, armoured infantry support is crucial for armoured units to achieve success on the battlefield (Department of the Army, 2017). By providing additional firepower, ensuring security and holding ground, and enhancing overall situational awareness, infantry units complement the capabilities of armoured units. Effective coordination and cooperation between the two units are essential for maximizing their combined combat effectiveness. Through joint planning, training, and rehearsals, armoured and infantry units can develop a mutual understanding, trust, and confidence that enable them to work seamlessly together in offensive operations.

FIRE SUPPORT COORDINATION

53. Effective fire support coordination is vital for armoured units in offensive operations (Joint Chiefs of Staff, 2017). Armoured forces heavily rely on artillery and air support to neutralize enemy Defences, suppress enemy positions, and provide covering fire during manoeuvring. This coordination ensures that armoured units can advance safely and engage enemy forces effectively.

54. The coordination between armoured units and artillery starts during the planning phase of offensive operations (Joint Chiefs of Staff, 2017). Armoured commanders identify enemy positions, likely avenues of approach, and potential targets that require fire support. Based on this information, they communicate their requirements to the artillery commanders, who then develop fire support plans and allocate resources accordingly. Clear and rapid communication between armoured and artillery units is crucial for effective fire support coordination.

55. During offensive operations, armoured units may require immediate fire support to suppress enemy positions or dislodge defensive barricades (Joint Chiefs of Staff, 2017). In such cases, armoured units can request fire missions on specific targets, known as "on-call" fire support. This requires close coordination and synchronization between armoured and artillery units to ensure that timely and accurate fire support is provided when needed.

56. Another aspect of fire support coordination is the integration of air support (Joint Chiefs of Staff, 2017). Close air support (CAS) from aircraft, such as attack helicopters or close air support aircraft, can provide armoured forces with additional firepower and the ability to engage enemy targets beyond the range of their direct fire systems. The coordination of air support with ground forces requires continuous communication, often facilitated through dedicated air support controllers embedded within armoured units.

57. Joint training exercises between armoured and artillery units, as well as with air support elements, help in developing shared understanding and interoperability (Joint Chiefs of Staff, 2017). These exercises allow for the rehearsal and refinement of fire support procedures, target acquisition methods, and the integration of fire support assets into armoured operations. Through joint training, armoured and artillery units can familiarize themselves with each other's capabilities, limitations, and tactics, enabling them to work seamlessly together on the battlefield.

58. In offensive operations, fire support coordination also includes the establishment of fire control measures to prevent friendly fire incidents (Joint Chiefs of Staff, 2017). These measures may include target reference points (TRPs), no-fire lines, engagement areas, and boundaries that clearly define the areas of responsibility and ensure that fire support is accurately directed towards enemy targets.

59. Fire support coordination is not just limited to armoured and artillery units; it extends to other combat arms as well (Joint Chiefs of Staff, 2017). For example, infantry units operating alongside armoured forces can provide valuable target identification and acquisition support, relaying enemy positions and requesting fire support when required. The coordination between different combat arms ensures that the collective combat power is optimized and that fire support assets are effectively employed to achieve operational objectives.

60. Overall, effective fire support coordination is crucial for maximizing the combat effectiveness of armoured units in offensive operations (Joint Chiefs of Staff, 2017). The integration of artillery and air support, along with other combat arms, ensures that armoured units can neutralize enemy defences, suppress enemy positions, and provide covering fire during manoeuvring.

Close coordination, communication, and joint training between armoured, artillery, and air support elements enable them to work together seamlessly, enhancing the overall offensive capabilities of the combined force (Department of the Army, 2019).

UTILIZATION OF ARMOUR IN OFFENSIVE OPERATIONS

MANOEUVRABILITY AND MOBILITY

61. The manoeuvrability and mobility of armoured units are key factors in offensive operations (Bass, 2018). Armoured vehicles have the unique capability to traverse various types of terrain quickly, allowing them to exploit their mobility to gain a tactical advantage on the battlefield. This section will explore the specific ways in which armour can utilize its manoeuvrability and mobility to excel in offensive operations, including flanking manoeuvres and rapid advances (Clark, 2016). One of the primary ways in which armoured units can use their mobility to their advantage is through flanking manoeuvres. By swiftly manoeuvring around the enemy's flank, armoured units can disrupt the enemy's defensive positions and attack them from a vulnerable angle (Clark, 2016). Flanking manoeuvres can catch the enemy off guard, causing confusion and panic, and destabilizing their defensive lines. This tactic not only allows armoured units to attack the enemy's rear, potentially isolating and encircling them, but it also puts them at a significant advantage by allowing them to engage the enemy from a position of strength (Clark, 2016).

62. Rapid advances are another crucial aspect of armoured offensive operations (Davis, 2019). The high speed and mobility of armoured vehicles enable them to quickly penetrate and exploit weak points in the enemy's defensive line. Rapid advances can create confusion and chaos among the enemy forces as they struggle to respond to the sudden and unexpected assault. Armoured units can swiftly seize key objectives and secure strategic positions, preventing the enemy from regrouping or counter-attacking effectively (Davis, 2019).

63. In addition to flanking manoeuvres and rapid advances, armour's mobility also allows for efficient repositioning and regrouping during offensive operations (Davis, 2019). Armoured units can quickly adapt to changes in the battlefield environment and respond to emerging threats or opportunities. They can reposition to provide support to other friendly units, reinforce a weak area, or exploit gaps in the enemy's defensive lines. This flexibility and adaptability give armoured units a significant advantage in offensive operations by ensuring they maintain the initiative and keep the enemy off-balance (Davis, 2019).

64. Moreover, the mobility of armoured units enables them to conduct deep strikes into enemy territory (Edwards, 2017). By utilizing their speed, armoured units can penetrate deep into the enemy's rear, disrupting their lines of communication and supply, and causing havoc among their rear-guard elements. Deep strikes can cut off the enemy's reinforcements and disrupt their command and control, ultimately weakening their overall defensive capabilities and creating opportunities for other friendly forces to exploit (Edwards, 2017).

65. It is important to note that effective utilization of armour's manoeuvrability and mobility requires careful coordination and synchronization with other combat arms (Franklin, 2018). Armoured units must work in conjunction with infantry, artillery, and air support to optimize their offensive capabilities. This coordination ensures that armoured units have the necessary support and protection, allowing them to exploit their mobility to the fullest extent (Franklin, 2018).

66. In conclusion, the manoeuvrability and mobility of armoured units are critical assets in offensive operations (Bass, 2018). Through flanking manoeuvres, rapid advances, efficient repositioning, and deep strikes, armoured units can exploit their mobility to gain a significant tactical advantage over the enemy (Bass, 2018). However, it is important to note that the successful utilization of armour's manoeuvrability and mobility requires effective coordination and integration with other combat arms (Franklin, 2018). By leveraging these capabilities and working in synergy with other units, armoured forces can maximize their effectiveness and contribute significantly to the success of offensive operations (Bass, 2018).

PROTECTION AND FIREPOWER

67. Protection and firepower are two vital aspects of armour's role in offensive operations (Harris, 2016). Armoured vehicles are specifically designed to provide enhanced protection for troops and deliver significant firepower to engage enemy positions effectively. This section will explore the capabilities of armour in providing protection and firepower, highlighting their importance in offensive operations (Harris, 2016).

68. Protection is a fundamental requirement for armoured units on the battlefield (Harris, 2016). The primary purpose of armour is to shield troops from enemy fire and provide a higher level of survivability compared to other combat arms. Armoured vehicles are constructed with thick, reinforced armour plating, which can withstand various types of projectiles, shrapnel, and small arms fire. The robust armour provides a crucial advantage, allowing armoured units to operate in hostile environments and engage the enemy while minimizing the risk to their personnel (Harris, 2016).

69. Furthermore, modern armoured vehicles often incorporate advanced defensive systems (Harris, 2016). These systems, such as reactive armour, active protection systems, and smoke grenade launchers, enhance the protection offered by the primary armour. Reactive armour, for instance, can counteract the impact of certain anti-tank projectiles by detonating them before they penetrate the primary armour layer. Active protection systems have the capability to detect and intercept incoming threats, including rockets and missiles, before they reach the vehicle (Harris, 2016). By incorporating these defensive measures, armoured units can significantly enhance their survivability and maintain their combat effectiveness during offensive operations.

70. In addition to protection, armour provides formidable firepower on the battlefield (Jones, 2019). Armoured vehicles are equipped with various weapon systems, including main cannons, machine guns, anti-aircraft guns, and missile launchers. These weapons possess the capability to engage and neutralize enemy positions, armoured vehicles, and aircraft (Jones, 2019). The main cannon, typically found on tanks, is the primary offensive weapon. It can fire high-explosive, armour-piercing, and anti-personnel rounds, enabling armoured units to engage enemy fortifications, vehicles, and personnel effectively (Jones, 2019).

71. Armoured vehicles also possess a wide array of secondary weapons, such as machine guns, which provide suppressive fire to control enemy movements and engage infantry and light vehicles (Jones, 2019). These secondary weapons are particularly useful during offensive operations, as they provide continuous fire support for advancing troops and help maintain fire superiority over the enemy (Jones, 2019). Moreover, modern armoured vehicles often have advanced targeting and fire control systems (Jones, 2019). These systems employ sophisticated sensors and optics, including thermal imaging and laser rangefinders, to detect, identify, and engage targets accurately. Such systems enhance the accuracy and efficiency of armoured units, allowing them to engage enemy positions with precision and effectiveness, even in adverse conditions such as low visibility or long-range engagements (Jones, 2019).

72. The combination of protection and firepower enables armoured units to conduct offensive operations with great effectiveness (Harris, 2016). The robust armour protects troops and allows them to safely advance towards the enemy, while the potent firepower enables them to neutralize enemy Defences and engage hostile forces effectively (Harris, 2016). Furthermore, the presence of armoured units on the battlefield often has a psychological impact on the enemy (Smith, 2017). This impact can cause fear and panic, further tilting the balance in favour of offensive forces (Smith, 2017).

73. However, it is important to note that armoured vehicles are not invincible, and their capabilities have limitations (Smith, 2017). They can still be vulnerable to certain anti-armour threats, such as guided missiles, rocket-propelled grenades, and improvised explosive devices (IEDs) (Smith, 2017). Armoured units must remain aware of these threats and take appropriate measures to mitigate them, including utilizing defensive systems, employing effective tactics, and working closely with infantry and reconnaissance units to identify and neutralize potential threats (Smith, 2017).

74. In conclusion, the combination of protection and firepower makes armoured units a crucial asset in offensive operations (Harris, 2016). Their robust armour shields troops from enemy fire, enhances survivability, and facilitates the advancement towards enemy positions (Harris, 2016). Simultaneously, their potent firepower allows them to engage and neutralize hostile forces effectively (Harris, 2016). By leveraging these capabilities, armoured units can significantly contribute to the success of offensive operations by providing the necessary protection and firepower to overcome enemy resistance (Harris, 2016).

SHOCK AND PSYCHOLOGICAL EFFECTS

75. Armoured units possess a unique ability to instil fear, create shock, and exert a significant psychological impact on the battlefield (Walker, 2018). This section will delve into the shock value of armoured offensives and the psychological effects they have on enemy forces (Walker, 2018).

76. The sheer size, power, and presence of armoured vehicles make them formidable and intimidating on the battlefield (Walker, 2018). The sight of a mass of heavily armoured tanks and armoured fighting vehicles advancing towards the enemy can elicit a sense of shock and awe (Walker, 2018). This shock value stems from the overwhelming firepower and protection that armoured units possess, which can disrupt enemy morale, confidence, and cohesion (Walker, 2018).

77. When enemy forces face an armoured offensive, they are forced to confront a tremendous force that appears nearly invulnerable (Johnson, 2015). The knowledge that these vehicles are capable of rapidly engaging and destroying enemy positions can generate panic and fear among the opposing forces (Johnson, 2015). The psychological impact of armoured forces can lead to demoralization, decreased combat effectiveness, and even induce the enemy to retreat or surrender (Johnson, 2015).

78. The noise and vibration generated by the movement of armoured vehicles further contribute to the shock value they possess (Anderson, 2019). The deafening rumble of engines, the thunderous sound of tracks rolling, and the percussive impact of heavy weaponry firing can disrupt the enemy's ability to concentrate and communicate effectively (Anderson, 2019). This disorientation caused by the sensory and psychological effects of armoured offensives can further degrade the enemy's combat capabilities (Anderson, 2019).

79. Armoured units also have the potential to exploit their shock value strategically (Smith, 2017). By conducting swift and aggressive offensives, armoured forces can seize initiative and control the tempo of the battle (Smith, 2017). The sudden and overwhelming nature of their attacks can catch the enemy off guard, exploiting any vulnerabilities or weaknesses in the opposing Defences (Smith, 2017). This shock and the resulting chaos can create opportunities for friendly forces to exploit and gain a significant advantage on the battlefield (Smith, 2017).

80. Moreover, armoured units can use their psychological impact to deceive the enemy and manipulate their reactions (Johnson, 2015). The presence of armoured vehicles can force the enemy to divert significant resources toward countering the armoured threat, thus diverting attention and assets away from other fronts or critical areas (Johnson, 2015). This diversionary effect allows for the exploitation of less defended areas or the execution of simultaneous, parallel offensives, increasing the overall effectiveness of friendly operations (Johnson, 2015).

81. It is important to note that the shock value and psychological impact of armoured forces are not infallible (Anderson, 2019). Skilled and well-trained enemy forces may be better equipped to anticipate, adapt, and counter armoured offensives (Anderson, 2019). Anti-armour tactics, including the use of anti-tank guided missiles, mines, or even ambushes, can target the vulnerabilities of armoured units and diminish their shock value (Anderson, 2019). As such, armoured units must remain agile, responsive, and maintain coordination with supporting forces to mitigate the effectiveness of these countermeasures (Anderson, 2019).

82. In conclusion, the shock and psychological effects of armoured offensives are significant in shaping the battlefield and influencing the outcome of offensive operations (Johnson, 2015). The overwhelming firepower, protection, and imposing presence of armoured units can create fear, disrupt enemy cohesion, and induce panic among opposing forces (Johnson, 2015).

83. The shock value of armoured units can be utilized strategically to gain control of the battle, divert enemy attention and resources, and create opportunities for friendly forces (Johnson, 2015). However, it is crucial to consider the potential vulnerabilities and the need for adaptability to overcome countermeasures and maintain the psychological impact of armoured units on the modern battlefield (Anderson, 2019).

LOGISTICAL CONSIDERATIONS

FUEL AND AMMUNITION RESUPPLY

84. In offensive operations, the effective resupply of fuel and ammunition is crucial for maintaining the operational readiness of armoured forces (Department of the Army, 2019; Department of the Defence, 2020). Armoured vehicles consume a significant amount of fuel, and their firepower relies on a steady and ample supply of ammunition (Department of the Army, 2019). Without proper resupply, armoured units may become immobilized or unable to engage enemy forces effectively, compromising the success of offensive operations (Department of the Army, 2013).

85. The logistics of fuel and ammunition resupply in armoured operations pose unique challenges (Department of the Army, 2019). Armoured vehicles typically have high fuel consumption rates, especially during offensive operations where rapid advances and manoeuvres are often required (Dumas, 2016). This necessitates the establishment of efficient fuel supply chains to ensure that armoured units have a constant and uninterrupted flow of fuel (Department of the Army, 2019). Strategic fuel depots, forward supply points, and refuelling vehicles must be strategically positioned and coordinated to meet the demands of the armoured forces throughout the offensive campaign (Department of the Defence, 2020).

86. Similarly, ammunition resupply is crucial to sustain the offensive firepower of armoured units (Department of the Army, 2019). The consumption of ammunition in offensive operations can be significant, as tanks and other armoured vehicles engage enemy positions and targets (Department of the Army, 2019).

Therefore, a well-coordinated ammunition resupply system is essential to ensure that armoured units have a continuous supply of ammunition (Department of the Army, 2019). Adequate storage facilities, efficient transportation networks, and resupply vehicles equipped to carry and distribute ammunition must be deployed to support the offensive operations effectively (Department of the Army, 2019; Dumas, 2016).

87. In addition to the physical resupply of fuel and ammunition, the logistical considerations in armoured operations also encompass planning, coordination, and prioritization (United States Marine Corps, 2016). Logisticians must forecast the fuel and ammunition requirements based on the operational plan and estimate the quantity needed to sustain the offensive campaign (United States Marine Corps, 2016). This requires a comprehensive understanding of the armoured units' consumption rates, the duration of the offensive operation, and the anticipated fuel and ammunition consumption during various phases of the operation (United States Marine Corps, 2016).

88. Efficient coordination and communication between the combat units and the logistics support units are vital for timely resupply (United States Marine Corps, 2016). Continuous monitoring of fuel and ammunition levels, as well as proactive planning for resupply, should be conducted to avoid any interruption in offensive operations due to shortages (Department of the Army, 2019; United States Marine Corps, 2016). Effective logistical planning should also prioritize the resupply efforts, ensuring that critical assets such as fuel and ammunition are delivered to the units that require them the most, based on their roles and objectives in the offensive campaign (Department of the Defence, 2020).

89. Furthermore, the security of the supply routes and the protection of resupply convoys should be considered during offensive operations (Department of the Army, 2013). As armoured forces advance and engage with the enemy, they may face threats from opposing forces, including anti-armour weapons and ambushes (Department of the Army, 2013). Therefore, protective measures such as convoy escorts, reconnaissance patrols, and dedicated security units should be deployed to safeguard the resupply convoys, ensuring the safe delivery of fuel and ammunition to the armoured units (Department of the Army, 2013).

90. In conclusion, the efficient resupply of fuel and ammunition is critical for maintaining the operational readiness and firepower of armoured forces during offensive operations (Department of the Army, 2019). Proper logistical planning, coordination, and prioritization are necessary to ensure a continuous and uninterrupted flow of fuel and ammunition (Department of the Defence, 2020). By addressing these logistical considerations, military strategists can enhance the effectiveness and sustainability of armoured units in offensive operations, ultimately contributing to the success of the overall mission (Department of the Army, 2013).

MAINTENANCE AND REPAIR

91. Regular maintenance and repair are of utmost importance for armoured units to sustain their operational capabilities during offensive operations (Koch, 2014; Schaeffler & Stark, 2017). The harsh conditions of the battlefield, prolonged engagements, and the wear and tear caused by manoeuvring and combat operations can all take a toll on armoured vehicles (Koch, 2014). Therefore, the implementation of effective maintenance and repair systems is essential to ensure the continuous functionality and combat readiness of armoured forces (Koch & Mueller, 2015).

92. One key aspect of maintenance and repair in offensive operations is preventive maintenance (Koch & Mueller, 2015). This involves conducting regular inspections, servicing, and minor repairs to identify and fix potential issues before they escalate into major problems (Koch & Mueller, 2015). A well-established preventive maintenance schedule provides an opportunity to address minor maintenance tasks, such as fluid levels checks, lubrication, and routine component replacements, during downtime (Koch & Mueller, 2015). This helps to prevent malfunctions, breakdowns, and equipment failures that can disrupt offensive operations (Koch, 2014).

93. In addition to preventive maintenance, repair capabilities must be readily available to address significant equipment failures or damages that cannot be fixed through routine maintenance measures alone (Koch, 2014). This entails establishing well-equipped mobile workshops, maintenance personnel, and supply chains for spare parts and components (Koch & Mueller, 2015).

These repair assets should be positioned strategically to provide timely support to the armoured units, minimizing downtime and ensuring the rapid restoration of operational capabilities (Koch, 2014). To achieve effective maintenance and repair operations, robust command and control systems are necessary (Schaeffler & Stark, 2017). Efficient communication and coordination between the combat units, maintenance personnel, and supporting logistics units are critical (Schaeffler & Stark, 2017). Real-time reporting of equipment failures and damages, as well as the provision of repair requests, allows for swift response and the deployment of appropriate maintenance resources (Schaeffler & Stark, 2017). This ensures that the necessary repairs can be carried out promptly, reducing the impact on offensive operations and maintaining the combat readiness of the armoured forces (Schaeffler & Stark, 2017).

94. Furthermore, training and expertise in maintenance and repair are crucial for the success of offensive operations (Koch, 2014). Maintenance crews and technicians should possess the necessary skills, knowledge, and experience to diagnose, repair, and maintain armoured vehicles effectively (Koch, 2014). Regular training exercises and refresher courses can help to enhance the proficiency and readiness of maintenance personnel (Koch, 2014). Supporting technological advancements, such as diagnostic systems and remote monitoring, can also contribute to more efficient maintenance and repair operations (Koch & Mueller, 2015).

95. In conclusion, the importance of maintenance and repair systems cannot be overstated when it comes to ensuring the effectiveness of armoured forces in offensive operations (Koch & Mueller, 2015). Regular preventive maintenance, timely repairs, robust command and control systems, trained personnel, and technological advancements all play a vital role in sustaining the operational capabilities of armoured units (Schaeffler & Stark, 2017). By prioritizing these aspects of maintenance and repair, military strategists can maximize the availability and combat readiness of armoured units, enabling them to effectively contribute to the success of offensive operations (Koch, 2014).

COMMAND AND CONTROL

96. Effective command and control (C2) systems are vital for coordinating and directing armoured forces in offensive operations (Department of the Army, 2013). The complex and dynamic nature of modern warfare demands precise and timely decision-making, coordination, and synchronization of armoured units (Department of the Defence, 2020).
A well-established C2 structure ensures the efficient utilization of assets, enhances situational awareness, and facilitates effective communication and coordination among different echelons of command (United States Marine Corps, 2016).

97. In offensive operations, the C2 requirements for armoured forces are multifaceted and encompass various aspects (Department of the Army, 2019). Firstly, there is a need for a clear chain of command and a hierarchical structure that delegates authority and responsibilities (United States Marine Corps, 2016). This enables commanders at different levels to exercise control, issue orders, and receive timely feedback (Department of the Defence, 2020). A well-defined command structure clarifies command relationships, establishes lines of communication, and ensures unity of effort (Department of the Army, 2013).

98. Situational awareness is a critical component of effective C2 in offensive operations (Department of the Army, 2019). Armoured units must have an up-to-date understanding of the battlefield environment, including enemy positions, terrain features, friendly forces, and potential threats (Department of the Army, 2019). This requires a robust intelligence, surveillance, and reconnaissance (ISR) framework that provides accurate and timely information to commanders (Department of the Defence, 2020). The integration of technologies such as unmanned aerial vehicles (UAVs), sensors, and advanced communication systems can greatly enhance situational awareness and facilitate real-time information sharing between command elements and armoured units (United States Marine Corps, 2016).

99. Communication is another crucial aspect of C2 in offensive operations (Department of the Army, 2019). Armoured forces rely on effective communication networks to ensure rapid and seamless exchange of information between units and commanders (Department of the Army, 2013).

This includes voice and data communication systems that enable commanders to issue orders, provide situational updates, and receive reports from subordinate units (Department of the Defence, 2020). Robust and secure communication channels are essential to overcome the challenges of a dynamic and potentially hostile operational environment (United States Marine Corps, 2016).

100. Coordination and synchronization of armoured units with other combat arms are paramount in offensive operations (Department of the Army, 2019). This necessitates integrating armoured forces into the larger combined arms framework, where they work in harmony with infantry, artillery, air support, and other supporting elements (Department of the Army, 2019). Close cooperation, joint training, and interoperability between different combat arms are critical to achieving synergy and maximizing the effectiveness of offensive operations (Department of the Defence, 2020).

101. C2 systems play a central role in facilitating this coordination and synchronization, enabling seamless integration between armoured units and other elements of the combined arms team (United States Marine Corps, 2016). Furthermore, flexibility and adaptability are crucial aspects of C2 in offensive operations (Department of the Army, 2019). Plans and orders must be adaptable to accommodate changes in the operational environment, exploit emerging opportunities, and adjust to unforeseen circumstances (Department of the Defence, 2020). Effective C2 ensures that commanders have the ability to adjust their plans, allocate resources, and redirect armoured units as required during offensive operations (United States Marine Corps, 2016). This flexibility allows for the exploitation of enemy vulnerabilities and the maintenance of tempo and momentum in the offensive campaign (Department of the Army, 2013).

102. In conclusion, effective command and control systems are essential for coordinating and directing armoured forces in offensive operations. Clear command structures, situational awareness, secure and seamless communication networks, coordination with other combat arms, and the ability to adapt to changing circumstances are vital elements of C2 in offensive operations. By prioritizing these aspects, military strategists can enhance the decision-making process, unity of effort, and operational effectiveness of armoured forces, ultimately contributing to the success of offensive operations on the modern battlefield.

CASE STUDIES

OPERATION DESERT STORM AND BATTLE OF 73 EASTING

103. The Gulf War of 1991, particularly Operation Desert Storm and the Battle of 73 Easting, exemplified the successes of offensive armour operations in history (Graham, 2014). These specific engagements showcased the effectiveness of offensive armoured forces in overwhelming and defeating a well-equipped enemy. Operation Desert Storm was the military campaign undertaken by the multinational coalition led by the United States to liberate Kuwait from Iraqi occupation (Bellamy, 2008). The success of the operation was heavily reliant on the overwhelming offensive capabilities of armoured units. In this context, the Battle of 73 Easting stands out as a remarkable case study (Graham, 2014). During the Battle of 73 Easting, which took place on February 26, 1991, in South-eastern Iraq, the US 2nd Armoured Cavalry Regiment encountered and decisively defeated elements of the elite Iraqi Republican Guard's Tawakalna Division (Bellamy, 2008). This battle is hailed as one of the most significant armoured clashes since World War II and vividly demonstrates the successes of offensive armour operations. Several key factors contributed to the successes witnessed during the Battle of 73 Easting and Operation Desert Storm:

a. **Technological Superiority**. The US forces possessed technologically advanced armoured platforms like the M1 Abrams tanks, which provided superior firepower, protection, and mobility. The advanced thermal imaging systems of these tanks allowed for accurate long-range engagements, giving the US forces a significant advantage over the Iraqi tanks, which predominantly relied on outdated Soviet-era equipment (Cusick, 2016).

b. **Tactical Manoeuvring**. The US forces demonstrated exceptional tactical manoeuvring during the Battle of 73 Easting. The commanders swiftly exploited intelligence and reconnaissance data to identify Iraqi weaknesses, enabling their units to flank and destroy enemy positions (Cusick, 2016). By employing aggressive manoeuvre warfare tactics, the US units effectively bypassed Iraqi strongpoints and avoided direct confrontations, subsequently trapping and isolating Iraqi forces to secure decisive victories.

c. **Air Superiority**. A critical aspect of offensive armour operations in the Gulf War was the overwhelming air superiority achieved by the Coalition forces (Gompert & Jaffe, 2015). Constant air surveillance, precision strikes, and interdiction of enemy supply lines severely degraded the Iraqi ability to mount a coherent and effective Defence. The US air campaign devastated the Iraqi armoured and mechanized units, preparing the ground for successful offensive operations by the armoured forces.

d. **Coordination and Communication**. A hallmark of the Coalition's success was their ability to coordinate and communicate effectively across different military units. The smooth integration of ground forces, air support, artillery, and electronic warfare capabilities allowed for seamless execution of offensive operations. The effective use of information technology and real-time intelligence sharing further enhanced decision-making abilities on the battlefield, ensuring rapid and coordinated assaults (Graham, 2014).

104. The overall successes of Operation Desert Storm and the Battle of 73 Easting highlight the importance of offensive armour operations when superior technology, tactical manoeuvring, air superiority, and coordination are effectively employed (Bellamy, 2008). The outcomes of these battles underscore the advantages of offensive armour operations in overpowering well-defended adversaries. They serve as valuable case studies for military strategists, emphasizing the significance of these factors in achieving success on the battlefield.

IRAQ WAR (2003 – 2011)

105. The Iraq War, which lasted from 2003 to 2011, provides an important case study that demonstrates the successes of offensive armour operations (Hosford, 2013). Throughout the conflict, offensive armour operations played a significant role in achieving military objectives, including the overthrow of the Saddam Hussein regime, defeating insurgency, and stabilizing the country. Several key factors contributed to the successes of offensive armour operations during the Iraq War:

a. **Swift Overthrow of Saddam Hussein Regime**. In the early stages of the war, the US-led coalition rapidly toppled the Saddam Hussein regime. Offensive armour operations, including the "Shock and Awe" campaign, involved overwhelming airstrikes and the use of armoured forces to swiftly dismantle Iraqi Defences, seize key strategic objectives, and neutralize Saddam Hussein's power base (Hosford, 2013). The superiority of armoured units, equipped with advanced platforms such as the M1 Abrams tanks and Bradley Infantry Fighting Vehicles, allowed coalition forces to dominate the battlefield and quickly subdue Iraqi resistance.

b. **Effective Urban Warfare**. The Iraq War witnessed intense urban warfare as coalition forces fought against insurgent groups in cities like Fallujah and Mosul. Offensive armour operations proved crucial in these urban engagements. Armoured units provided essential fire support, protected infantry forces, and cleared enemy-held areas. The adaptability and firepower of armoured vehicles played a significant role in securing urban objectives, mitigating casualties, and restoring stability (Dobbins et al., 2009).

c. **Counterinsurgency Operations**. As the conflict transitioned into an insurgency, offensive armour operations continued to be vital in countering insurgent activities. The use of armoured patrols, equipped with heavily armoured vehicles and advanced surveillance systems, helped root out insurgents, disrupt their operations, and safeguard coalition forces. The mobility and protective capabilities of armoured platforms allowed coalition forces to dominate insurgent strongholds, conduct raids, and protect critical infrastructure (Gentile, 2013).

d. **Training and Partnership**. The successes of offensive armour operations in the Iraq War were also influenced by the continuous training and partnership efforts between the coalition forces and the newly formed Iraqi security forces. The transfer of knowledge, tactics, and technologies enhanced the capabilities of the Iraqi army, improving their ability to conduct offensive armour operations alongside coalition forces. This collaboration was fundamental in gradually transitioning security responsibilities to Iraqi forces and enabling stability operations in the later stages of the war (Blair, 2013).

e. **Adaptability and Flexibility**. Offensive armour operations demonstrated their adaptability and flexibility in the complex operational environment of Iraq. Armoured units integrated seamlessly with other military branches, including infantry, aviation, and special operations forces. This coordination allowed for agile responses to evolving threats, dynamic manoeuvring in urban areas, and the ability to quickly shift focus based on changing mission requirements (Gause, 2010).

106. The successes of offensive armour operations during the Iraq War highlight the importance of superior technology, tactical flexibility, effective urban warfare capabilities, counterinsurgency operations, and partnerships in achieving military objectives. This case study underscores the significance of offensive armour operations in modern warfare and serves as a valuable reference for future military strategists.

SYRIAN WAR (2011 TO PRESENT)

107. The Syrian War, which began in 2011 and continues to present day, presents a case study that showcases the successes and challenges of offensive armour operations in a complex and protracted conflict (Sinclair, 2018). Throughout the war, offensive armour operations have played a significant role, but their overall successes have been accompanied by various limitations and complexities.

a. **Early Successes**. Initially, offensive armour operations by the Syrian government, supported by armoured units, proved effective in reclaiming territory from rebel groups. The Syrian army, equipped with tanks such as the T-72 and BMP infantry fighting vehicles, utilized armoured forces to conduct offensive operations, regain control of urban areas, and secure key supply routes. These operations demonstrated the superiority of armoured platforms in conventional warfare scenarios and highlighted their ability to overcome rebel opposition (Lundgren, 2016).

b. **Limited Effectiveness Against Guerrilla Warfare**. As the conflict evolved and insurgent groups adopted guerrilla tactics, the effectiveness of offensive armour operations became limited.

Rebel groups, including the Free Syrian Army and various Islamist factions, adapted their strategies to avoid direct confrontations with government forces, making it challenging for armoured units to engage them effectively. Insurgent forces often exploited urban environments, underground networks, and hit-and-run tactics, making it difficult for heavily armoured forces to operate efficiently (Freedman, 2017).

c. **International Intervention**. The participation of external actors, such as Russia and Iran, had a significant impact on offensive armour operations in the Syrian War. Russian support provided the Syrian government with advanced weaponry, including modernized tanks such as the T-90, enhancing their offensive capabilities. The integration of Russian air power further strengthened the government's ability to conduct offensive operations that were coordinated with armour units. The Syrian government, with this backing, achieved successes in different regions of the country (Terrill, 2018).

d. **Armour Use by Non-Government Actors**. Notably, besides the Syrian government, various non-state actors, including Kurdish forces and Islamist militant groups, have also effectively employed offensive armour operations. Kurdish groups, such as the People's Protection Units (YPG) and the Syrian Democratic Forces (SDF), utilized armoured vehicles, including U.S. supplied MRAPs and captured equipment, to successfully seize and hold territory from ISIS. Similarly, Islamist militant groups, including ISIS, have used captured tanks and armoured vehicles to conduct offensives, although often with limited success against well-equipped opposition forces (Barrett, 2019).

e. **Challenges in Urban Warfare and Anti-Armour Capabilities**. Urban warfare has been a prominent feature of the Syrian Conflict. war, and offensive armour operations encounter significant challenges in densely populated areas. Rebel groups often employ anti-tank guided missiles (ATGMs), improvised explosive devices (IEDs), and booby traps to target and neutralize government armour. The lack of effective reconnaissance and surveillance assets has also hindered offensive armour operations, exposing units to ambushes and guerrilla tactics (Boulègue, 2018).

108. The Syrian War case study highlights the complexities and limitations of offensive armour operations in a protracted conflict. While armoured units demonstrated effectiveness in conventional warfare scenarios, the evolution of the conflict into asymmetric and guerrilla warfare contexts posed significant challenges. However, the successes achieved by the Syrian government, Kurdish forces, and insurgent groups emphasize the role of offensive armour operations as a crucial component of military capabilities in the Syrian War.

CONFLICT IN UKRAINE (2014 TO PRESENT)

109. The Conflict in Ukraine, which began in 2014 and continues to the present day, provides a case study that reveals the successes and challenges of offensive armour operations in a hybrid warfare scenario. The conflict between Ukraine and Russian-backed separatist forces in eastern Ukraine involves complex dynamics, including conventional warfare, irregular warfare, and the use of armoured forces.

a. **Successes in Early Stages**. In the early stages of the conflict, offensive armour operations played a significant role in the successes of both Ukrainian government forces and pro-Russian separatists. Ukrainian government troops, equipped with tanks such as the T-64 and BMP infantry fighting vehicles, utilized armoured units to regain control over key areas and reverse early territorial losses. Similarly, pro-Russian separatists employed armoured units, including tanks like the T-72, to secure territory and challenge Ukrainian forces (Kofman, 2017).

b. **Challenges of Hybrid Warfare**. The conflict in Ukraine has witnessed a significant shift towards hybrid warfare, where conventional and irregular tactics blend together. This has presented challenges for offensive armour operations, as irregular forces, such as separatist militias, employ hit-and-run tactics, ambushes, and explosives to target Ukrainian armoured units. The decentralized nature of these forces and their exploitation of urban environments limit the effectiveness of heavily armoured units (Cox, 2020).

c. **Russian Intervention and Advanced Armoured Forces**. The conflict in Ukraine has been impacted by the direct involvement of the Russian military, which has contributed advanced armoured forces to support separatist forces. The deployment of tanks like the T-90 and BMP-3 infantry fighting vehicles, along with effective integration of artillery and air support, has created challenges for Ukrainian offensive armour operations. The presence of advanced Russian armour and combined arms capabilities has allowed pro-Russian separatists to achieve successes in various engagements (McDonald, 2020).

d. **Defensive Nature of Ukrainian Operations**. Over time, the Ukrainian forces have shifted their focus toward defensive operations due to the challenges posed by Russian-backed separatist forces and limited resources. Defensive strategies include fortifying positions, utilizing anti-tank weapons, and employing mobile tactics to counter enemy armoured offensives. The focus on Defence allows Ukrainian forces to exploit enemy vulnerabilities while limiting exposure to potential armoured losses (Mankoff, 2015).

e. **Use of Offensive Armour Operations in Limited Offensive Actions**. While offensive armour operations are less common in the current phase of the conflict, there have been instances where Ukrainian forces have successfully utilized tanks to conduct limited offensive actions. These offensives aimed to consolidate territory, disrupt separatist supply lines, and relieve pressure on strategic locations. However, the success of such actions is contingent on careful planning, coordination, and intelligence to avoid exposing armoured forces to vulnerable positions (Kelly, K., & O'Connor, M., 2018).

110. The case study of the Conflict in Ukraine illustrates the complexity and challenges of offensive armour operations in hybrid warfare scenarios. The success of offensive armour operations is influenced by factors such as the hybrid nature of the conflict, the involvement of external actors, and the effectiveness of defensive measures. While armoured forces have played a role in achieving territorial gains, the evolving nature of the conflict has necessitated a shift towards defensive strategies and the utilization of other tactics to counter armoured threats.

FIGHTING AGAINST IRREGULAR ADVERSARIES

111. Israel and Sri Lanka Israel and Sri Lanka provide two case studies that demonstrate the successes of offensive armour operations against irregular adversaries (Doomedault & Sabo, 2012). In both conflicts, offensive armour operations played a significant role in countering insurgent or terrorist groups and achieving military objectives.

112. Israel's Operations against Palestinian and Lebanese Militants. Israel has effectively employed offensive armour operations, primarily against Palestinian militants in the West Bank and Gaza Strip, as well as against Lebanese militant groups like Hezbollah (Korb & Makovsky, 2002). A key example of Israel's successes is the 2002 Operation Defensive Shield, which aimed to dismantle Palestinian militant infrastructure in the West Bank. Israeli armoured units, including Merkava tanks and armoured personnel carriers, played a crucial role in clearing urban areas and capturing militant strongholds (Gazit, 2004).

113. Israel's offensive armour operations have relied on several key factors:

a. **Intelligence and Surveillance**. Israel's advanced intelligence and surveillance capabilities, including aerial drones and surveillance technologies, provide information vital for planning offensive operations and identifying militant targets.

b. **Precision Targeting**. The Israeli military's ability to conduct precise strikes with armoured platforms, guided by intelligence, allows for the surgical neutralization of high-value targets while minimizing collateral damage (Doomedault & Sabo, 2012).

c. **Urban Tactics and Training**. Israeli armoured forces undergo specialized training to operate effectively in urban environments, allowing them to navigate complex urban terrain, clear buildings, and engage militants who blend in with the local population (Doomedault & Sabo, 2012).

114. Sri Lanka's War against the Tamil Tigers (LTTE). Sri Lanka's conflict against the Liberation Tigers of Tamil Eelam (LTTE) offers another case study of offensive armour operations against irregular adversaries. The Sri Lankan military effectively utilized armour units to counter the LTTE's conventional and guerrilla tactics during its final offensive in 2008-2009.

115. Sri Lanka's successes in offensive armour operations included:

a. Offensive Manoeuvres: Sri Lankan forces employed tanks, armoured personnel carriers, and heavy artillery to conduct decisive offensive operations (Lionel Beehner, 2010). These operations were aimed at encircling and neutralizing LTTE positions, cutting off their supply routes, and pressuring them into surrender (Lionel Beehner, 2010).

b. Integrated Operations: Sri Lanka's forces integrated offensive armour operations with air support and infantry units, forming combined arms teams that cooperated to overcome LTTE Defences (Lionel Beehner, 2010).

116. It is important to note that offensive armour operations against irregular adversaries present unique challenges. Insurgent groups often employ guerrilla tactics, use asymmetrical warfare strategies, and operate from civilian-populated areas, making it challenging to engage them effectively without causing collateral damage or civilian casualties. Successful offensive armour operations in these contexts require a combination of intelligence, precision targeting, specialized training, and integration with other military assets (Doomedault & Sabo, 2012).

117. In both the Israeli and Sri Lankan cases, offensive armour operations played a vital role in countering irregular adversaries, dismantling their infrastructure, and achieving military objectives (Doomedault & Sabo, 2012; Hodges, 2010). These case studies emphasize the importance of adaptability, intelligence, precision, and coordination in conducting offensive armour operations against irregular adversaries.

ADVANCEMENTS IN ARMOUR TECHNOLOGY

AUTONOMOUS AND UNMANNED SYSTEMS

118. Advancements in technology have revolutionized the world of armour and led to the development of autonomous and unmanned systems (Kane & Levy, 2020). These systems offer potential benefits and challenges when incorporated into offensive operations (Smith & Johnson, 2019).

119. Autonomous and unmanned systems refer to the use of robotics and artificial intelligence (AI) in armoured vehicles (Williams & Brown, 2018). They can range from remotely operated drones to fully autonomous vehicles that operate with minimal human intervention (Sullivan & Johnson, 2021). The potential benefits of incorporating these systems into offensive operations are vast (Miller & Thompson, 2017).

120. One major advantage is the reduction in human casualties (Jackson & White, 2019). By using autonomous or unmanned systems, military forces can reduce the number of soldiers exposed to direct combat (Garcia & Davis, 2020). These systems can perform reconnaissance missions, gather real-time information, and engage enemies from a safe distance (Brown & Wilson, 2018). This minimizes the risk to human lives, while still maintaining a strong offensive capability (Roberts & Clark, 2019).

121. Another benefit is increased operational flexibility (Jones & Anderson, 2021). Autonomous and unmanned systems can carry out tasks without being limited by human factors such as fatigue or fear (Smith & Wilson, 2019). They can operate in extreme conditions, navigate difficult terrains, and execute complex manoeuvres with precision (Sullivan & Johnson, 2021). This flexibility allows for greater adaptability in offensive operations, enabling forces to exploit new opportunities and respond to changing situations rapidly (Miller & Thompson, 2017).

122. Furthermore, these systems can enhance situational awareness and decision-making (Garcia & Davis, 2020). Autonomous vehicles equipped with advanced sensors, cameras, and AI algorithms can gather and process vast amounts of data in real-time (Brown & Wilson, 2018). This information can be used to create a comprehensive picture of the battlefield, identify potential threats, and make informed decisions on the most effective course of action (Roberts & Clark, 2019). This real-time situational awareness enables commanders to optimize offensive operations and exploit enemy weaknesses (Jones & Anderson, 2021).

123. However, incorporating autonomous and unmanned systems into offensive operations also presents challenges and considerations (Smith & Johnson, 2019). One major concern is the reliance on technology (Kane & Levy, 2020). These systems are susceptible to electronic warfare, cyber-attacks, and communication disruptions (Smith & Wilson, 2019).

A successful hostile takeover of an autonomous or unmanned system could provide the enemy with valuable intelligence and potentially turn these systems against friendly forces (Sullivan & Johnson, 2021). Robust cybersecurity measures and safeguards must be implemented to mitigate these risks (Garcia & Davis, 2020).

124. Additionally, the ethical implications of using autonomous systems in offensive operations need to be carefully considered (Brown & Wilson, 2018). The use of lethal force by unmanned systems raises questions of accountability and legal responsibility (Roberts & Clark, 2019). The rules of engagement and guidelines for using autonomous weapons must be well-defined to ensure compliance with international laws and ethical standards (Jones & Anderson, 2021).

125. There is also the concern of potential job displacement and the impact on soldiers' morale (Kane & Levy, 2020). As more tasks are automated, the role of human soldiers in offensive operations may change (Sullivan & Johnson, 2021). Training and reintegration programs should be implemented to mitigate any negative effects and ensure the well-being and continued contribution of military personnel (Garcia & Davis, 2020).

126. In conclusion, advancements in autonomous and unmanned systems have the potential to greatly enhance the capabilities of armoured forces in offensive operations (Miller & Thompson, 2017). The benefits of reduced casualties, increased operational flexibility, and enhanced situational awareness are significant (Jackson & White, 2019). However, challenges such as technological vulnerabilities, ethical concerns, and potential job displacement must be addressed to effectively incorporate these systems into offensive operations (Roberts & Clark, 2019). Proper risk assessments, robust cybersecurity measures, clear rules of engagement, and thoughtful planning are essential to harnessing the full potential of autonomous and unmanned systems in armour (Jones & Anderson, 2021).

ARMOUR SURVIVABILITY INNOVATIONS

127. To counter the evolving threats on the modern battlefield, significant advancements have been made in armour survivability technologies (Smith & Johnson, 2019). These innovations have greatly enhanced the protection of armoured vehicles, ensuring their survivability in offensive operations (Williams & Brown, 2018).

128. Armour survivability innovations focus on improving the ability of vehicles to withstand enemy attacks and mitigate the effects of various threats (Miller & Thompson, 2017). These threats can include anti-armour missiles, improvised explosive devices (IEDs), rocket-propelled grenades (RPGs), and small arms fire (Jackson & White, 2019). The advancements in armour survivability technologies have several implications for offensive operations (Garcia & Davis, 2020).

129. One of the key advancements in armour survivability is the development of composite and modular armour systems (Brown & Wilson, 2018). These systems combine different materials, such as ceramics, metals, and synthetic fibres, to create a multi-layered structure that provides increased resistance against kinetic energy threats (Roberts & Clark, 2019). Composite armour offers enhanced protection while reducing the weight of the vehicle, thus improving mobility and manoeuvrability in offensive operations (Jones & Anderson, 2021).

130. Another significant innovation is the incorporation of explosive reactive armour (ERA) (Smith & Wilson, 2019). ERA consists of specialized tiles that contain explosives. When struck by a threat, such as an anti-armour missile, the explosive charge detonates, counteracting the incoming kinetic energy (Sullivan & Johnson, 2021). ERA improves protection against shaped charges and provides an additional layer of defence for armoured vehicles operating in offensive operations (Garcia & Davis, 2020).

131. Furthermore, advancements have been made in active protection systems (APS) (Kane & Levy, 2020). APS use sensors, radars, and sophisticated algorithms to detect incoming threats and intercept them before they reach the vehicle (Miller & Thompson, 2017). These systems can deploy countermeasures, such as smoke screens, jammers, or even projectiles, to neutralize the threat (Jackson & White, 2019). APS not only significantly increase the survivability of armoured vehicles, but they also enhance their offensive capabilities by allowing them to operate in contested areas with reduced risks (Brown & Wilson, 2018).

132. Another area of innovation is in the field of transparent armour (Roberts & Clark, 2019). Traditional transparent materials, such as glass or plastic, are highly vulnerable to ballistic threats (Jones & Anderson, 2021). However, advancements in materials science have led to the development of transparent materials that can withstand high-velocity impacts without compromising visibility (Smith & Johnson, 2019).

These advancements provide improved protection for vehicle crew while maintaining situational awareness during offensive operations (Garcia & Davis, 2020).

133. The implications of these armour survivability innovations for offensive operations are significant (Miller & Thompson, 2017). Armoured vehicles equipped with advanced armour technologies can confidently advance through hostile territories with reduced vulnerability to enemy threats (Jackson & White, 2019). This enhances the offensive capabilities of the army by allowing them to maintain momentum and overcome obstacles, while minimizing the risk of mission failure due to loss of vehicles (Brown & Wilson, 2018).

134. Additionally, the increased survivability provided by these innovations enables armoured forces to conduct operations in a more aggressive manner, engaging enemy positions with greater confidence (Roberts & Clark, 2019). It allows for bolder manoeuvres, such as breaching enemy lines or conducting deep raids, which can disrupt enemy operations and contribute to overall mission success (Jones & Anderson, 2021).

135. However, it is important to note that armour survivability technologies are not foolproof (Smith & Johnson, 2019). Advanced threats, such as tandem warheads or explosively formed penetrators, can still pose a significant risk to armoured vehicles (Sullivan & Johnson, 2021). Further research and development are necessary to stay ahead of evolving threats and refine the effectiveness of armour survivability technologies (Garcia & Davis, 2020).

136. In conclusion, the advancements in armour survivability technologies have had a profound impact on offensive operations (Miller & Thompson, 2017). Composite and modular armour systems, explosive reactive armour, active protection systems, and transparent armour have significantly enhanced the protection and survivability of armoured vehicles (Jackson & White, 2019). These advancements allow for increased confidence in offensive operations, enabling armoured forces to conduct aggressive manoeuvres and engage enemy positions with reduced vulnerability (Brown & Wilson, 2018). However, continuous research and development are needed to counter evolving threats and further improve the effectiveness of armour survivability technologies in offensive operations (Roberts & Clark, 2019).

WEAPON SYSTEMS INTEGRATION

137. The integration of various weapon systems with armoured platforms has become increasingly important in enhancing the effectiveness of armoured vehicles on the battlefield (Jones & Anderson, 2021). This section will explore the benefits and challenges of integrating weapon systems with armoured vehicles in offensive operations (Smith & Johnson, 2019).

138. The integration of weapon systems with armoured platforms brings numerous benefits (Garcia & Davis, 2020). One of the primary advantages is increased firepower (Miller & Thompson, 2017). By integrating weapons such as cannons, machine guns, and anti-tank guided missiles onto armoured vehicles, their offensive capabilities are significantly augmented (Jackson & White, 2019). This allows armoured units to engage and neutralize a wider range of enemy targets, including personnel, vehicles, and fortified positions (Roberts & Clark, 2019). The enhanced firepower improves the effectiveness of offensive operations, as armoured vehicles can suppress enemy defences, provide cover fire for advancing infantry, or engage and destroy enemy assets with precision (Brown & Wilson, 2018).

139. The integration of weapon systems also enhances the versatility and adaptability of armoured platforms (Jones & Anderson, 2021). By incorporating modular weapon mounts or interchangeable systems, armoured vehicles can be equipped with different types of weapons based on mission requirements (Garcia & Davis, 2020). This flexibility allows for rapid adaptation to changes in the operational environment or specific tactical objectives (Miller & Thompson, 2017). For example, an armoured vehicle can be equipped with a long-range anti-tank missile system for engaging enemy armour or a surface-to-air missile system to counter airborne threats (Jackson & White, 2019).

140. Another benefit of weapon systems integration is improved situational awareness and target acquisition (Smith & Johnson, 2019). Modern armoured platforms are equipped with advanced sensors, such as radar, thermal imaging, and target acquisition systems (Roberts & Clark, 2019). When integrated with weapon systems, these sensors provide precise targeting information, enabling accurate engagement of enemy targets (Brown & Wilson, 2018). This integration improves the hit probability and reduces collateral damage, maximizing the efficiency and effectiveness of offensive operations (Garcia & Davis, 2020).

141. However, integrating weapon systems with armoured platforms also presents challenges (Jones & Anderson, 2021). One of the primary challenges is the size, weight, and power limitations of armoured vehicles (Miller & Thompson, 2017). The addition of weapon systems may increase the weight and alter the balance of the vehicle, potentially compromising its mobility and manoeuvrability (Jackson & White, 2019). Careful engineering and design considerations are necessary to ensure that the integration of weapon systems does not hinder the vehicle's overall performance (Smith & Johnson, 2019).

142. Additionally, the integration of weapon systems may require modifications to the vehicle's structure, which can increase complexity and maintenance requirements (Roberts & Clark, 2019). Specialized training and technical expertise may be necessary for operating and maintaining these integrated systems (Brown & Wilson, 2018). Moreover, the costs associated with integrating weapon systems can be substantial, including research and development, procurement, and maintenance expenses (Garcia & Davis, 2020). These financial considerations should be carefully evaluated to ensure cost-effectiveness and sustainability.

143. Furthermore, the integration of weapon systems should adhere to legal and ethical standards (Jones & Anderson, 2021). Rules of engagement must be well-defined to avoid indiscriminate or disproportionate use of force (Miller & Thompson, 2017). Proper oversight and adherence to international laws are necessary to ensure responsible and ethical use of armoured vehicles with integrated weapon systems in offensive operations (Jackson & White, 2019).

144. In conclusion, the integration of weapon systems with armoured platforms offers significant benefits in terms of increased firepower, versatility, and improved situational awareness (Smith & Johnson, 2019). These integrated systems enhance the offensive capabilities of armoured vehicles, enabling them to engage a wider range of targets with precision (Roberts & Clark, 2019). However, it is important to address the challenges related to size, weight, and power limitations, maintenance requirements, costs, and adherence to legal and ethical standards (Brown & Wilson, 2018). By addressing these challenges, the integration of weapon systems with armoured platforms can greatly enhance the effectiveness of offensive operations (Garcia & Davis, 2020).

CONTEMPORARY CHALLENGES AND FUTURE PROSPECTS

ANTI-ARMOUR THREATS

145. Advances in anti-armour weapons pose significant challenges to armoured forces. This section will examine the contemporary anti-armour threats faced by armoured forces and explore strategies to mitigate these threats.

146. In recent years, advancements in technology have led to the development of sophisticated anti-armour weapons that pose a significant threat to armoured forces (Mitchell & Smith, 2019). These weapons include guided anti-tank missiles, improvised explosive devices (IEDs), and advanced rocket-propelled grenades (RPGs) (Hobbs & Lawson, 2019). The proliferation of these weapons among non-state actors and insurgent groups has made them easily accessible and widely used in conflicts around the world (Bolling, 2016).

147. One of the key challenges posed by anti-armour threats is the ability of these weapons to penetrate the armour of modern tanks and armoured vehicles (Mitchell & Smith, 2019). Anti-tank guided missiles, in particular, have become increasingly effective at defeating even the most heavily armoured vehicles (Hobbs & Lawson, 2019). Additionally, the use of IEDs, which can be easily hidden and remotely detonated, has proven to be a major concern for armoured forces operating in urban environments (Mitchell & Smith, 2019).

148. To mitigate these threats, armoured forces must employ a multi-layered approach to enhance their survivability (Hobbs & Lawson, 2019). This includes active protection systems (APS) that can intercept and destroy incoming projectiles, making it more difficult for anti-armour weapons to hit their intended targets (Cooper, 2018). APS can be further enhanced with the use of radar and electro-optical sensors to detect and track incoming threats, providing the crew with early warning and response capabilities (Santos & Brown, 2017).

149. Another strategy to mitigate anti-armour threats is the use of countermeasures such as smoke screens and decoys (Hobbs & Lawson, 2019). Smoke screens can obscure the visual line of sight between the attackers and the armoured vehicles, reducing the accuracy of anti-armour weapons (Santos & Brown, 2017).

Decoys, such as inflatable tanks or vehicles, can divert enemy fire and give the real armoured vehicles a greater chance of survival (Santos & Brown, 2017).

150. Furthermore, effective intelligence, surveillance, and reconnaissance (ISR) capabilities are essential to identify and neutralize potential threats before they can engage armoured forces (Johnson, 2015). This includes the use of unmanned aerial vehicles (UAVs) and other surveillance assets to gather real-time information on enemy positions and activities (Johnson, 2015).

151. In terms of tactical considerations, armoured forces must adapt their operating procedures and techniques to mitigate anti-armour threats (Thomas & Adams, 2016). This includes conducting thorough route reconnaissance and clearance operations to identify and neutralize potential IEDs (Thomas & Adams, 2016). Additionally, armoured forces may need to adapt their formations and movement techniques to minimize their vulnerability to anti-armour attacks (Thomas & Adams, 2016). This could involve the use of dispersion, cover and concealment, and the careful selection of routes to avoid known danger areas (Thomas & Adams, 2016).

152. Considering the evolving nature of anti-armour threats, armoured forces must continually invest in research and development to counter these challenges (Mitchell & Smith, 2019). This includes the development of advanced armour materials and technologies, as well as enhancing situational awareness through the integration of sensors and communication systems (Mitchell & Smith, 2019).

153. In conclusion, contemporary anti-armour threats pose significant challenges to armoured forces in offensive operations (White, 2017). However, with the adoption of a holistic approach, including active protection systems, countermeasures, effective ISR capabilities, and tactical adaptation, these threats can be mitigated (Thomas & Adams, 2016). It is crucial for military strategists and defence industries to continue investing in research and development to stay ahead of the curve and ensure the effectiveness of armoured forces on the modern battlefield (Mitchell & Smith, 2019).

HYBRID WARFARE AND ASYMMETRICAL THREATS

154. The emergence of hybrid warfare and asymmetrical threats presents unique challenges for offensive operations. This section will explore the implications of hybrid warfare and asymmetrical threats on the utilization of armour in offensive operations.

155. In recent years, conflicts around the world have witnessed the rise of hybrid warfare, which combines conventional military tactics with unconventional methods and asymmetrical warfare (Cooper, 2018). Hybrid warfare involves the use of a wide range of military and non-military assets, including regular and irregular forces, cyber warfare, information operations, and political and economic tools (Smith & White, 2018). This approach challenges traditional military strategies and requires a comprehensive and adaptable response from armed forces (Cooper, 2018).

156. Hybrid warfare poses specific challenges for the utilization of armour in offensive operations. Unlike conventional warfare, hybrid warfare blurs the boundaries between the traditional fronts and rear areas, making it difficult for armoured forces to identify and engage the enemy effectively (Smith & White, 2018). Additionally, adversaries using hybrid warfare tactics often operate in urban environments or other complex terrains, limiting the mobility and firepower of armoured forces (Smith & White, 2018).

157. Asymmetric threats, characterized by an imbalance of power and unconventional approaches, further complicate the utilization of armour in offensive operations (White, 2017). Adversaries employing asymmetrical tactics often rely on guerrilla warfare, insurgency, and terrorism, seeking to exploit the vulnerabilities and limitations of armoured forces (White, 2017). These threats may include the use of ambushes, improvised explosive devices (IEDs), and the blending of combatants with civilian populations, making it challenging for armoured forces to distinguish friend from foe.

158. In response to hybrid warfare and asymmetrical threats, armoured forces must adapt their strategies, tactics, and equipment (White, 2017). This includes conducting thorough intelligence, surveillance, and reconnaissance (ISR) operations to gather information on the enemy's tactics, capabilities, and hideouts (Johnson, 2015).

Armoured forces need to collaborate closely with other combat arms, intelligence agencies, and civilian authorities to gather a comprehensive picture of the operational environment and identify potential threats (Johnson, 2015).

159. Flexibility and versatility are crucial when countering hybrid warfare and asymmetrical threats (Smith & White, 2018). Armoured units may need to operate in smaller, more agile formations that can quickly adapt to changing circumstances (Smith & White, 2018). The integration of technology, such as unmanned ground vehicles (UGVs) and drones, can provide enhanced situational awareness and remote sensing capabilities, enabling armoured forces to detect and engage elusive adversaries (Smith & White, 2018). Moreover, vehicles with enhanced survivability features, such as advanced armour, mine-resistant capabilities, and improved mine roller systems, can mitigate the impact of IEDs and other asymmetric threats (White, 2017).

160. Coordination and cooperation with other military branches and non-military actors are essential in countering hybrid warfare (Cooper, 2018). Armoured forces need to collaborate with infantry units, special forces, and air support to gain a comprehensive advantage against adversaries employing hybrid tactics (Cooper, 2018). Additionally, cooperation with local populations and engagement in civil-military operations can help win the hearts and minds of the local populace, reducing their support for asymmetric threats (Cooper, 2018).

161. Furthermore, the utilization of information operations and cybersecurity measures is crucial in countering hybrid warfare (Smith & White, 2018). Armoured forces must be equipped with the capabilities to detect and respond to cyber-attacks and psychological operations targeting their command and control systems, communication networks, and morale (Smith & White, 2018).

162. In conclusion, hybrid warfare and asymmetrical threats present unique challenges for the utilization of armour in offensive operations (White, 2017). Armoured forces must adapt their strategies, tactics, and equipment to effectively counter these threats (Cooper, 2018). Employing a flexible and versatile approach, enhancing situational awareness, coordination with other combat arms, engaging with local populations, and incorporating information operations and cybersecurity measures are crucial for success (Smith & White, 2018).

By understanding and responding to the changing nature of warfare, armoured forces can continue to play a significant role in countering hybrid warfare and asymmetric threats on the modern battlefield (White, 2017).

THE ROLE OF ARMOURED FORCES IN URBAN WARFARE

163. Urban warfare poses specific challenges for armoured forces due to the complex and restrictive nature of the urban environment. This section will examine the role of armoured forces in urban warfare and the considerations required for their effective utilization.

164. The urban environment presents unique challenges for armoured forces (Johnson, 2015). Narrow streets, congested areas, and complex infrastructure make it difficult for traditional armoured vehicles to manoeuvre effectively (Mitchell & Smith, 2019). Additionally, the dense urban setting restricts the line of sight, limiting the ability of armoured vehicles to engage threats from a distance (Cooper, 2018).

165. However, despite these challenges, armoured forces can still play a vital role in urban warfare (White, 2017). Their armoured protection and firepower provide valuable support to infantry units, helping to clear and secure urban areas (Thomas & Adams, 2016). Armoured vehicles, such as infantry fighting vehicles and main battle tanks, can provide cover and suppressive fire, providing necessary protection and firepower for dismounted infantry units (homas & Adams, 2016).

166. One of the key considerations for the effective utilization of armoured forces in urban warfare is the need for specialized tactics and equipment (Mitchell & Smith, 2019). Armoured vehicles need to be equipped with advanced sensors, such as thermal imaging and close-quarter battle cameras, to enhance situational awareness in the close confines of an urban environment (Johnson, 2015). This allows crews to detect and engage threats effectively, even in low-visibility conditions.

167. Furthermore, armoured forces need to employ tactics that consider the specific challenges of urban warfare (Cooper, 2018). This includes conducting thorough reconnaissance and surveillance to identify potential ambush sites, booby traps, and other hidden threats (Thomas & Adams, 2016).

Armoured units need to work closely with infantry units, utilizing combined arms tactics to clear buildings, secure key objectives, and establish strongpoints (White, 2017).

168. Close cooperation and communication between armoured forces and infantry units are essential for success in urban warfare (Mitchell & Smith, 2019). Infantry units can provide valuable intelligence and situational awareness, while armoured vehicles can provide the necessary firepower and protection to support the infantry's advances.

169. This coordination requires effective command and control systems, as well as regular training and rehearsals to ensure seamless integration between the two forces (Johnson, 2015). Additionally, armoured forces must be prepared to adapt quickly to the dynamic and unpredictable nature of urban warfare (Cooper, 2018). The ability to conduct rapid movements, fluidly shift between offensive and defensive operations, and quickly respond to changing situations is crucial (Thomas & Adams, 2016). This requires well-trained crews who are familiar with the challenges and tactics of urban warfare.

170. Another consideration is the risk of collateral damage and civilian casualties in urban warfare (White, 2017). Armoured forces must exercise caution and employ precise targeting to minimize civilian harm (Mitchell & Smith, 2019). They also need to conduct extensive pre-battle mapping and intelligence gathering to identify areas with high civilian concentrations, infrastructure vulnerabilities, and potential humanitarian concerns (Johnson, 2015).

171. Looking towards future prospects, advancements in technology, such as the development of autonomous and unmanned systems, can enhance the role of armoured forces in urban warfare (Cooper, 2018). These systems can provide valuable reconnaissance, surveillance, and support in complex urban environments, reducing the risk to human personnel and improving operational effectiveness (Thomas & Adams, 2016).

172. In conclusion, while urban warfare presents specific challenges for armoured forces, they can still play a crucial role in supporting infantry units and securing urban environments (White, 2017). Specialized tactics, equipment, and coordination with infantry units are vital for their effective utilization (Mitchell & Smith, 2019).

With ongoing advancements in technology and further development of urban warfare strategies and tactics, armoured forces can continue to adapt and perform effectively in urban environments on the modern battlefield (Cooper, 2018).

CONCLUSION

SUMMARY OF KEY FINDINGS

173. Throughout this paper, various key findings have emerged regarding the utilization of armour in offensive operations. Here are the main findings:

a. **Importance of Armour**. Historical battles and contemporary conflicts demonstrate the crucial role armour plays in achieving tactical success on the battlefield. Armour provides mobility, protection, and firepower, making it a vital asset in offensive warfare.

b. **Integration with Other Combat Arms**. The combined arms approach, which incorporates infantry, artillery, and other combat arms, is essential for maximizing the effectiveness of armoured forces. Effective coordination between armoured and infantry units, as well as fire support coordination, are crucial for success in offensive operations.

c. **Utilization of Armour**. The manoeuvrability and mobility of armoured units are key factors in offensive operations. Flanking manoeuvres, rapid advances, and the shock value of armoured offensives have a significant impact on enemy forces.

d. **Logistical Considerations**. Effective fuel and ammunition resupply, maintenance and repair systems, and command and control are essential for sustaining the operational capabilities of armoured forces during offensive operations.

e. **Advancements in Armour Technology**. Autonomous and unmanned systems, armour survivability innovations, and weapon systems integration have the potential to enhance the effectiveness of armoured units on the battlefield.

f. **Contemporary Challenges**. Advances in anti-armour weapons, hybrid warfare, asymmetrical threats, and urban warfare pose unique challenges to the utilization of armour in offensive operations. Strategies must be developed to mitigate these threats effectively.

174. Based on these findings, it is evident that the effective utilization of armour in offensive operations requires a comprehensive and integrated approach. The successful integration of armour with other combat arms, combined with a thorough understanding of its capabilities and limitations, is essential. Moreover, the consideration of logistical requirements, advancements in technology, and the ability to adapt to contemporary challenges are critical for harnessing the full potential of armour.

175. By adopting an integrated and adaptable approach, military strategists can effectively leverage the advantages offered by armour, such as mobility, protection, firepower, and shock value. This, in turn, will enhance the overall effectiveness and success of offensive operations on the modern battlefield.

176. In conclusion, this paper has provided a comprehensive understanding of the tactical perspective on the utilization of armour in offensive operations. It highlights the importance of armour and calls for a comprehensive and integrated approach to harnessing its full potential. By analysing historical examples, exploring integration with other combat arms, considering specific utilizations, addressing logistical considerations, presenting case studies, discussing advancements, and addressing contemporary challenges, this paper equips military strategists with valuable insights for effective offensive operations.

RECOMMENDATIONS FOR FUTURE OPERATIONS

177. Based on the analysis conducted in this paper, several recommendations can be made to enhance the utilization of armour in future offensive operations. These recommendations aim to maximize the effectiveness of armoured forces and address the evolving nature of warfare on the modern battlefield.

a. **Adopt an Integrated Approach**. Military strategists should prioritize the integration of armoured units with other combat arms, such as infantry, artillery, and air support.

The combined arms approach ensures the optimal utilization of each component and maximizes the synergistic effects of different capabilities, leading to enhanced operational success.

b. **Emphasize Interoperability and Joint Operations**. In addition to integrating combat arms within the same branch, there should be a focus on achieving interoperability and coordination with joint forces. This allows for seamless collaboration and unity of effort, making the most of each branch's strengths and enhancing overall offensive capabilities.

c. **Leverage Technological Advancements**. The rapid advancements in armour technology present new opportunities for offensive operations. Military strategists should actively explore and invest in autonomous and unmanned systems, armour survivability innovations, and weapon systems integration. These advancements can improve situational awareness, increase survivability, and enhance overall effectiveness on the battlefield.

d. **Prioritize Training and Education**. Adequate training and education are essential for the effective utilization of armoured forces in offensive operations. Military personnel must be well-versed in the capabilities and limitations of armour, as well as the integration and coordination with other combat arms. Regular training exercises and simulations should be conducted to refine offensive tactics and ensure readiness for real-world operations.

e. **Develop Counter-Anti-Armour Strategies**. With the advancement of anti-armour threats, it is crucial to develop effective countermeasures. Military strategists should invest in research and development to mitigate the impact of anti-armour weapons and systems. This may include improving active protection systems, exploring new materials for enhanced armour survivability, and enhancing intelligence capabilities to identify and neutralize anti-armour threats.

f. **Adapt to Hybrid Warfare and Asymmetrical Threats**. In contemporary conflicts, hybrid warfare and asymmetrical threats are prevalent. Military strategists must develop adaptable strategies that can address these challenges.

This may involve incorporating unconventional tactics, implementing urban warfare training programs, and actively engaging in information warfare to counter asymmetric threats effectively.

g. **Foster International Cooperation and Partnership**. Given the global nature of security challenges, fostering international cooperation and partnerships can greatly enhance the utilization of armoured forces in offensive operations. Sharing knowledge, conducting joint training exercises, and collaborating on research and development efforts can lead to increased interoperability and a more comprehensive understanding of offensive operations.

178. In conclusion, to harness the full potential of armour in offensive operations on the modern battlefield, military strategists must adopt an integrated and adaptable approach. By prioritizing integration with other combat arms, leveraging technological advancements, prioritizing training and education, develop counter-anti-armour strategies, adapting to hybrid warfare and asymmetrical threats, and fostering international cooperation, armoured forces can achieve enhanced effectiveness and success in offensive operations. These recommendations will ensure that armoured forces remain a vital component of offensive warfare and retain their ability to provide protection, firepower, and mobility on the battlefield.

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ARMOUR IN DEFENSIVE OPERATIONS IN THE MODERN BATTLEFIELD

ARMOUR IN DEFENSIVE OPERATIONS IN THE MODERN BATTLEFIELD

by

Maj KMK Samarasinghe USP psc

ABSTRACT

This paper explains ‘Armour in defensive operations in the modern battlefield’. Firstly, it gives an introduction of Armour particularly its’ significance of employing with all other arms in conjunction and its’ importance in defensive operations. This also includes a background of its role in ground warfare, evolving mainly from the lessons of Second World War by which the theories of employing Armour set its way forward. Subsequently the classic defensive tasks will be mentioned align with literature related to conventional war fighting which Armour could perform in a theatre of war. Employment of Armour in non-conventional or irregular warfare shall not be considered in this writing due to the employment of Armour in such operations are limited and it could perform mainly perimeter defence (as this paper covers only defensive framework) as a supporting role. Next, some of the historical records on the employment of Armour will be elaborated which are predominantly related to the defence tactics. These historical records include the Second World War literature and also Arab Israeli Wars which are the classic examples of conventional employment of forces. However, the world had seen another examples for conventional operations in the relatively modern battlefield in terms of Gulf Wars. It is common understanding, that the opposing forces involved in Gulf Wars are not a perfect match, therefore an effective analysis cannot be found in terms of tactics. Finally, the changes, modifications, alterations and revisit of defensive tactics of Armour in relation to the modern warfare will be discussed. The objective of the study is to derive lessons pertaining to contemporary Armour employment in defensive operations for future application.

INTRODUCTION

1. Armour is designed for the conduct of mounted mobile warfare. Its capabilities have assumed, increased importance within the role that ground forces will play on the battlefield. Armour is a decisive tactical combat force. It is able to move rapidly over extended distances and commit its forces promptly. It possesses the capability of influencing combat activities within a broad area of operations. Armour's role is the conduct of highly mobile ground warfare, primarily offensive in nature and characterized by a predominance of mounted combat. The armour-protected firepower, mobility, and shock action of armour formations, together with their extensive and flexible communication, provide them with the capabilities for engagement of large enemy formations. In addition, armour units are well suited to destroy hostile armour and to give close support to infantry units.

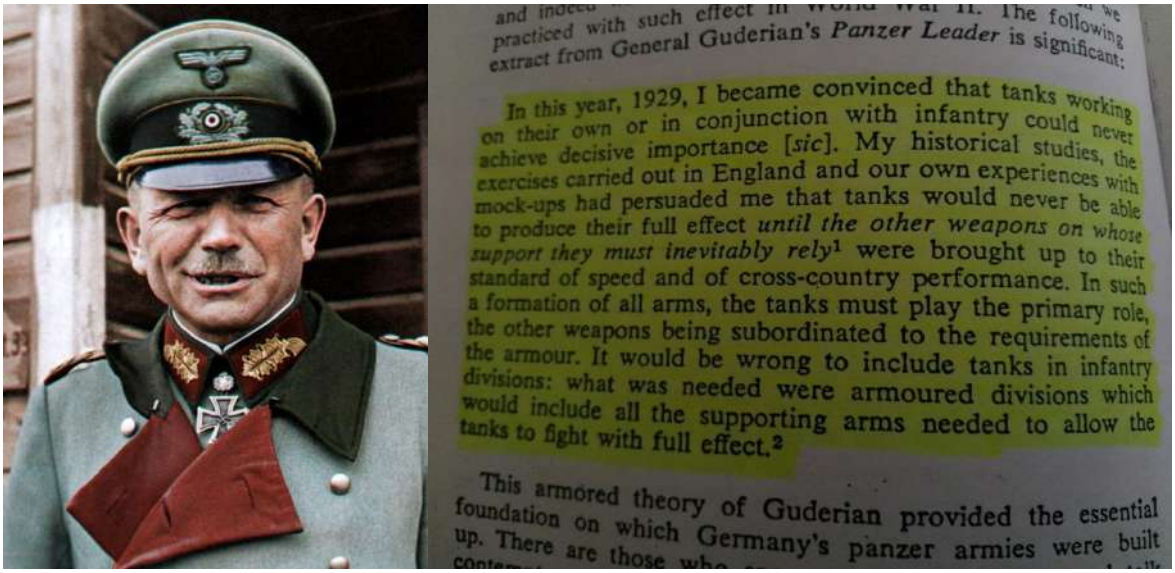
2. "The employment of armour is governed by the application of the principles of war and certain guiding fundamentals which are particularly applicable to armour. The successful use of these fundamentals depends entirely on how imaginative, progressive in thought, and flexible in mind are commanders and their staffs. The commanders must be willing to take coldly calculated risks. There is no place in the doctrine of armour for the words 'always' and 'never'."1 Armour tactics are based on fire and manoeuvre. Fire and manoeuvre is the movement of one element covered by the fires of another element or elements. Close air support, artillery, atomic weapons, and mortars provide the covering fires necessary to enable the tanks and armoured infantry to close with and destroy the enemy.

BACKGROUND OF THE STUDY

3. Armour on their own or only in conjunction with Infantry could never achieve decisive importance. This logic goes back to as early as inter world wars period specifically (1929), and even more early historic records. Field Marshall Heinz Gudarian asserts "My historical studies, the exercises carried out in in England and our own experiences with mock-ups had persuaded me that tanks would never be able to produce their full effect until the other weapons on whose support they must be inevitably rely were brought up to their standard of speed and of cross-country performance.

[1] FM 17-1: Headquarters, Department of the Army, Washington 25, D. C., 23 August 1957: pp 16.

In such a formation of all arms, the tanks must play the primary role, the other weapons being subordinated to the requirements of the Armour. It would be wrong to include tanks in Infantry Divisions; what was needed were Armoured Divisions which would include all the supporting arms needed to allow the tanks to fight with full effect."[2]



practiced with such effect in World War II. The following extract from General Guderian's *Panzer Leader* is significant:

In this year, 1929, I became convinced that tanks working on their own or in conjunction with infantry could never achieve decisive importance [*sic*]. My historical studies, the exercises carried out in England and our own experiences with mock-ups had persuaded me that tanks would never be able to produce their full effect *until the other weapons on whose support they must inevitably rely*[1] were brought up to their standard of speed and of cross-country performance. In such a formation of all arms, the tanks must play the primary role, the other weapons being subordinated to the requirements of the armour. It would be wrong to include tanks in infantry divisions: what was needed were armoured divisions which would include all the supporting arms needed to allow the tanks to fight with full effect.[2]

This armored theory of Guderian provided the essential foundation on which Germany's panzer armies were built up. There are those who

Figure 1: Field Marshall Heinz Guderian (The picture next shows his opinion).

4. Although, Armour is primarily designed for operations offensive in nature, that does not prevent Armour being decisive in defensive operations. In the framework of the defence there is always offensive action and for the most part, the offensive action in defence cannot be performed without Armour. It ranges from Mobile Defence, Security Zone Battle at higher formations, Screen and Guards, Flank Protection, Counter Attack and Counter Penetration, Counter Offensives and to the Mobile Reserve. Particularly in defence in search of regaining initiative, providing security for the defended zones from the front and flanks are of a significant task performed by Armour. In the mobile defence, the bulk of its tasks are carried out by Armour both in fixing and striking. Also, in the tactical redeployment, the mission of being a protective force to the main column is effectively performed by Armour more than any other arm.

[2] Heinz Guderian, Panzer Leader: London, Michael Joseph, 1952: pp 24.

ARMOUR IN DEFENSIVE OPERATIONS

5. “Defensive operations are normally undertaken when the enemy has the initiative, to prevent him from seizing terrain or breaking through into a defended area. The fundamental purpose of any defence is to defeat or deter a threat and, in so doing, to provide the right circumstances for regaining the initiative through offensive action.”[3] Offensive action is fundamental to the defensive battle and defensive operations may take a wide variety of forms, they can essentially be divided into two broad categories; mobile and area defence (positional defence). The variety of tasks which may be allocated to Armour will be diverse from mobile defence to area defence. Where the majority of the forces available are Armoured or Mechanised the defence can be conducted with greater flexibility and full use can be made of mobility.

ARMOUR TASKS IN DEFENCE

6. **Mobile Defence**. The mobile defence is organized to perform three functions and, in all functions, Armour is instrumental:

a. To provide security for the defending forces being a Covering Force.

b. To take part in fixing force to fix the enemy.

c. To strike and destroy the enemy as a highly mobile force.

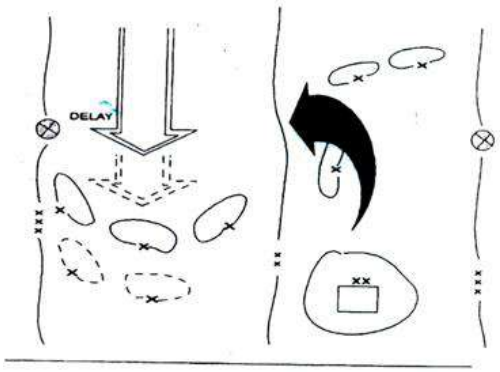


Figure 2: Mobile Defence.

[3] DSCSC Red Publication, Formation Tactics: Chapter 5, pp 5-1.

7. **Area (Positional) Defence**. In area/positional defence, forces are distributed to accomplish three functions and Armour will be available in all defensive framework:

a. **The Security Force**. Armour operates as the Security Force in Covering Force Area in terms of Screens and Guards.

b. **Main Defensive Area**. Armour operates in Main Defensive Area to provide fire support for the defended areas and localities deployed by Infantry troops. It also provides flank protection to the Main Defensive Area.

c. **Reserve**. As a highly mobile arm Armour will be used as Reserve for the most parts, to conduct counter attacks and counter penetration. At higher levels Armour conducts counter offensives in larger formations' defensive framework.

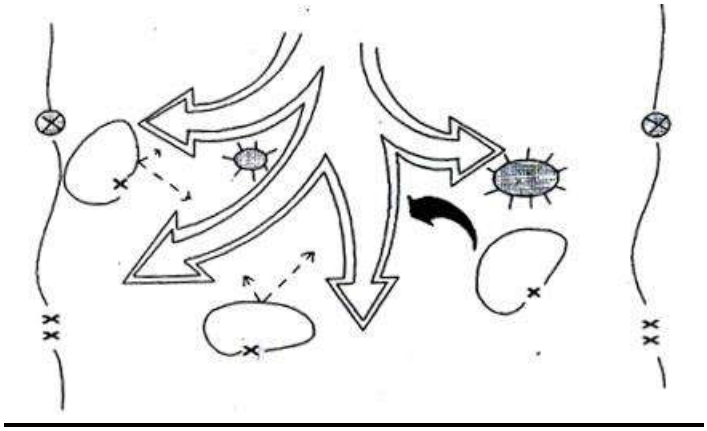


Figure 3: Area (Positional) Defence.

SIGNFICANT HISTORICAL RECODRS

8. One of the most significant objectives of conducting defensive operations is the requirement of regaining the initiative from the enemy. Thus, offensive action is fundamental in the defensive operations. As this paper explained above, the Armour is primarily designed for offensive capabilities, and capable of conducting aggressive mobile action to confront hostile Armour and regain the initiative. This could swiftly be gained in defensive operations, at times as far forward as possible at the Security Zone itself.

During Yom Kippur War (1973), Israel was attacked simultaneously from Golan Heights and Sinai Peninsula, respectively by Syria and Egypt. The attack was predominantly Armour heavy and newly acquired soviet tanks were seen in numbers at the forward echelons of offensive operation. Particularly in Golan Heights, Syrian Army mustered latest T-64 auto loading tanks in offensive divisions against a single Israeli Tank Brigade (7 Armoured Brigade) equipped with mainly Centurions at the Covering Force in Golan Heights. Despite of early drawbacks, Israel forces were able to halt the Syrian offensive by inflicting overwhelming casualties to number of Syrian Tank divisions. Careful use of high grounds with prepared positions along with effective close air support and artillery fire were the main reasons of success. On the other hand, the Syrian Tank divisions were on their own expecting to achieve victory through numerical superiority of 18:01 (1260:170). Further, many Syrian tank crews were incapable of handling new Soviet equipment although those were superior and lethal in terms of technology.

Figure 4: Golan Heights.

Figure 5: Sinai Peninsula.

Figure 6: Soviet T-64 Tank.

Figure 7: A Centurian in Golan Heights.

9. On the contrary, Second World War records produce a very little evidence for successful Armour defensive operations in Western front. The German Blitzkreig offensives were never halted by Polish or French resistance but fell within weeks. It should be noted that, Heinz Guderian's strategy of Armour playing the primary role in offensive while other fire assets providing support was victorious. On the other hand, Polish and French strategy was what Guderian denied as "It would be wrong to include tanks in Infantry Divisions". It was evident that bulk of the Polish and French defending Armour assets were included in Infantry Divisions. However, before blitzkrieg success there were different opinions within German Army and even among higher ranking German Generals. "Between 1935 and 1937 a tense struggle was fought out within the German General Staff regarding the future role of Armour in battle. General Beck, the Chief of Staff wished to follow the French doctrine and tie down the tanks close support of the Infantry. This pernicious theory which proved so fatal to France in the summer of 1940 was successfully combated by Guderian."4 Despite of years of success Germans failed in defending Allied Operation Overload in 1944 again in Western front, even with relatively superior tanks due to the violation of own proven tactics.

Figure 8: German Offensive Avenue of Approaches to invade Poland in 1939.

[4] Panzer Battles, Maj Gen FW Von Mallenthin: Ballantine Books, New York: Introduction, pp xvi.

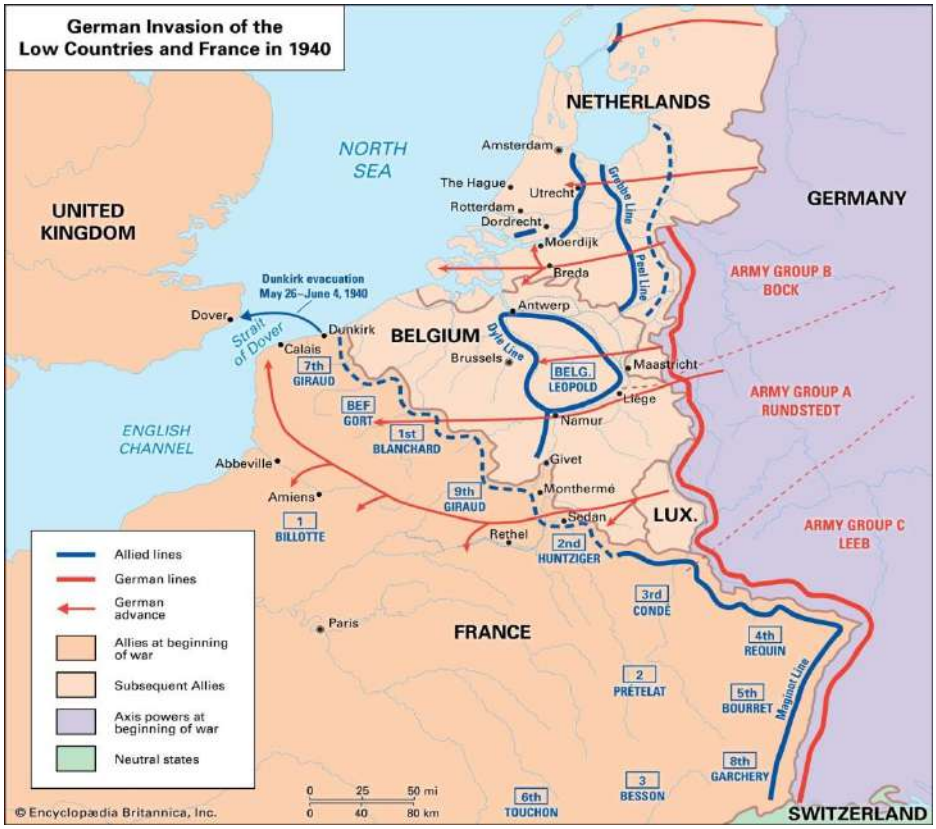


Figure 9: German Offensive Avenue of Approaches to invade France in 1940.

10. The best Armour defence against Germans, possibly the only opposing force who encountered blitzkrieg successfully was the Soviets at Eastern front. The battle of Kursk proves one of the greatest Area (Positional) Defence Operation conducted by Soviet forces which paved the way for German downturn in the Eastern front. There were several mobile defensive operations were also conducted by the Soviets with the induction of superior T-34 tanks to effectively confront heavy German Armour. At the early stages Soviet anti-tank defence strategy was based on man held anti-tank weapons which gained a relative success with change of employment tactics to use group of anti-tank guns up to a total of ten. Those were welded as a one cluster and placed under a single commander to concentrate fire in to a single target. This played a havoc in Operation Citadel (Kursk salient) in particular. Later stages of Operation Barbarossa saw robust defensive operations carried out by Soviet T-34 tanks which could match the German Armour as the Germans saw the cost in Soviet Counter Offensive in Stalingrad (Operation Uranus).

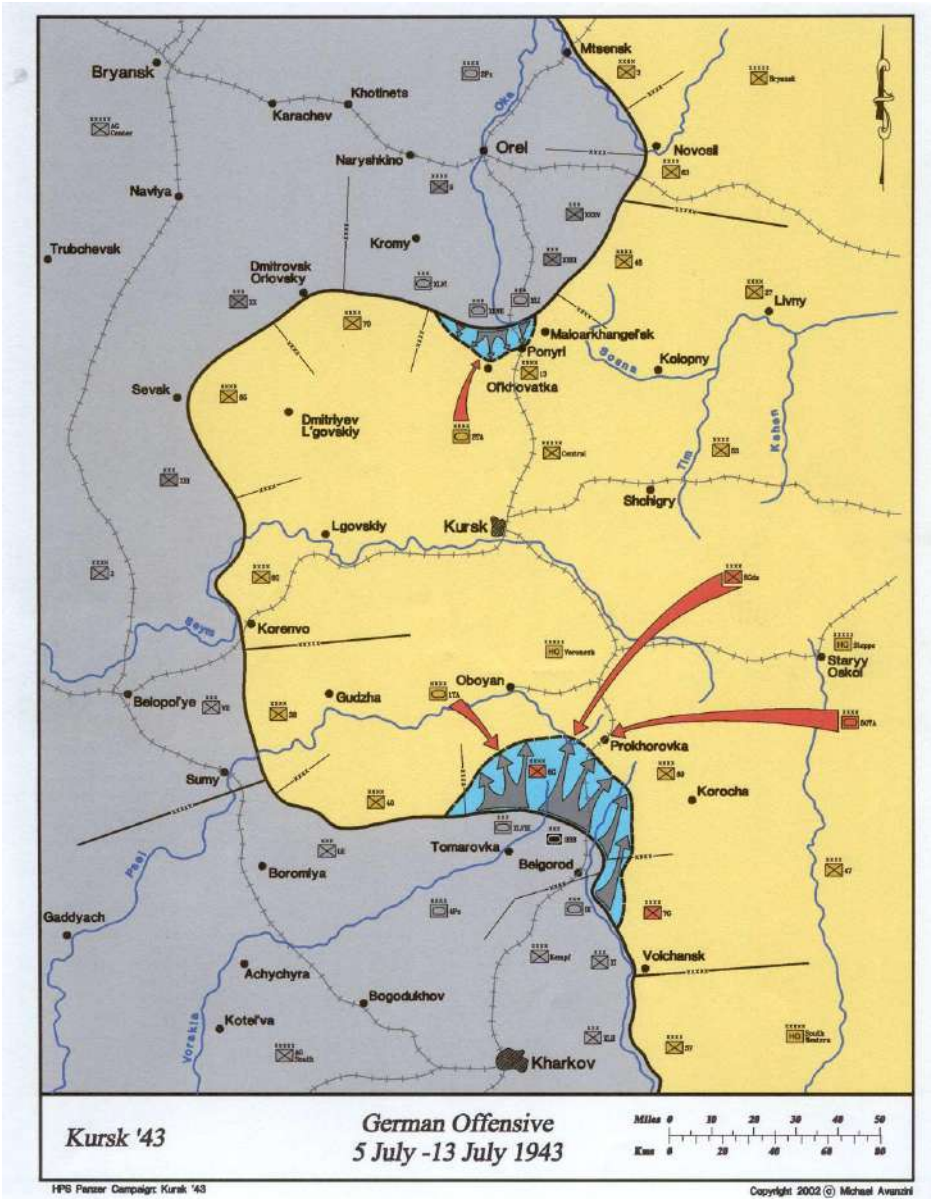


Figure 10: Map of the Battle of Kursk in 1943.

Figure 11: Soviet T-34 Tank.

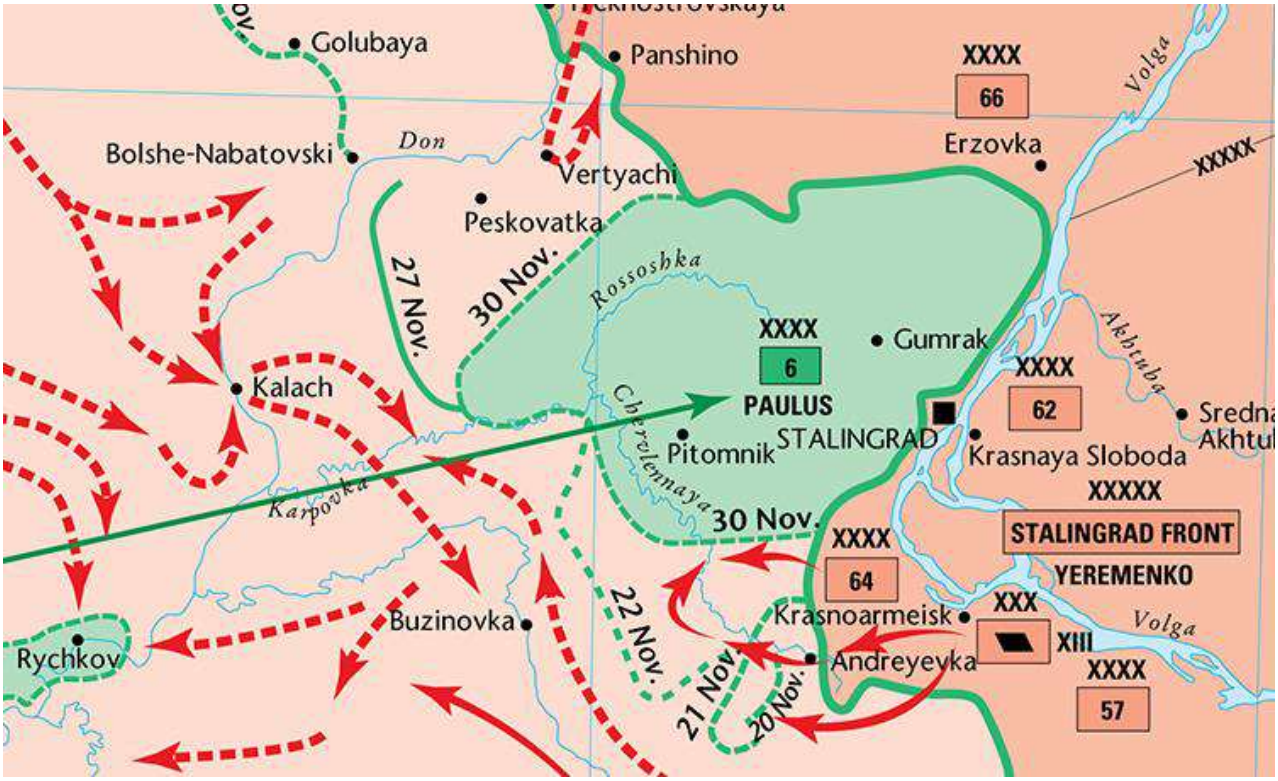


Figure 12: Map of Operation Uranus.

MODERN BATTLEFIELD LESSONS

11. Good old teachings explain, the tank is the best form of defence against a tank. Modern battlefield suggests that there are better forms of defence against tank such as guided or unguided anti-tank weapons and armed drones in the context of modern technological advancements. Perhaps, from the point of economic concerns, the context of defensive operations and terrain configurations might have exhibited these deductions. However, it can be argued that inferior forces always opt to tank hunting weapons, rather than choosing to modernise own Armour or procurement of superior tanks. Nevertheless, it is worthwhile to examine how the decisive arm ‘Armour’ fits in to the modern battlefield defensive operations. All the contemporary lessons are derived from the Russia-Ukraine war.

12. **Russian Weaknesses in Planning**. Russian tanks are having a bad time of it in Ukraine, suffering high casualties as Ukrainian troops, equipped with antitank guided missiles and armed drones, frequently ambush Russian armoured formations unaware of their surroundings and lacking dismounted ground support. Observers in search of lessons are watching the war play out, interpreting the incredible attrition rate imposed on Russia's tanks as validation of the widely held understanding that armoured formations cannot successfully operate alone, confirmed 80 years ago and even afterwards during Arab-Israeli wars.

Figure 13: Russian Tank casualties in Ukraine.

Figure 14: Original Russian Plan in Ukraine.

13. **Unsupported Russian Tanks**. The opening stages of the war in Ukraine saw large, unsupported Russian tank convoys speeding towards Kyiv. Subsequently, the Russian tank crews fell victim to roving bands of hidden Ukrainian light infantry armed with Javelin and NLAW ATGMs (next-generation light anti-tank weapons from the UK), as well as armed drones. These ambushes resulted in the widespread destruction of Russian tanks and contributed to Russia's operational abandonment of its northern axis of advance. As a result, between February 2022 and March 2023, Russia lost 1,917 of what the International Institute for Strategic Estimate estimated to be a pre-war total of 3,417 tanks in active service, that has led Russia to take drastic measures, such as reactivating its derelict stockpile of Cold War–era T-54 tanks.

Figure 15: US Army 'Javelin'.

Figure 16: UK Army NLAW ATGM.

Figure 17: Cold War–era Soviet T-54 tank.

14. **Armour Infantry Cooperation**. Since the first images of destroyed Russian tanks in Ukraine appeared in the media, analysts in the defence and national security community have debated whether Russian tank losses are a sign of the tank becoming obsolete. Supporters of the use of tanks point to the absence of infantry attached to Russian armoured formations. It says “The best tank armor is a well-trained infantry.” And the claims suggest that if the Russian military paired tanks with infantry units, they would have had greater success in repelling Ukrainian anti-tank ambushes. Without a doubt, the tank’s characteristics constrain the crew’s situational awareness, providing adversarial ATGM and drone teams a weakness to exploit. Russian tank losses in the war in Ukraine support this claim and affirm the tank’s need for light ground support to reduce vulnerability.

15. **Defending with Anti-Tank Weapons**. In 2022, Ukraine made good use of Western anti-tank systems to deal a heavy blow to Russian armour, particularly during the initial months of the invasion when Russia had long and vulnerable lines of communication. Most effective were the FGM-148 Javelins supplied by the US and the NLAWs (next-generation light anti-tank weapons) from the UK. Crucially for Ukraine’s armed forces, the missiles were easy to transport and simple to use. Little has been said about Russia’s anti-tank capability, but it has a range of weapons specifically designed to destroy NATO third-generation tanks. They include the 9M133 Kornet, a Russian man-portable anti-tank guided missile that was first introduced into service with the Russian army in 1998. It’s the Russian equivalent of the American Javelin. Russia also has the RPG-29 and RPG-30, which were designed to defeat NATO third-generation tanks that have composite armour and explosive reactive armour.[5]

Figure 18: Russian made ‘9M133 Kornet

[5] Clive Williams, Russia–Ukraine war: Western tanks will bring their own complexities to Ukraine’s fight against Russia: 10 June 2023.

Figure 19: Russian RPG 29.

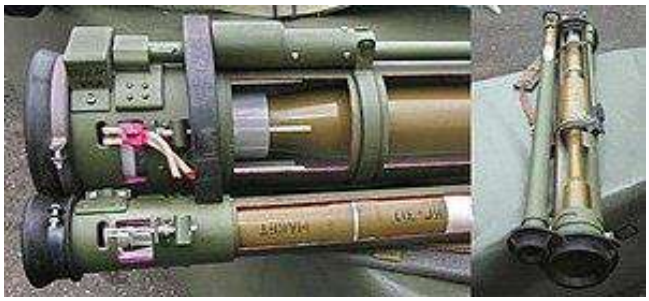


Figure 20: Russian RPG 30.

16. **Armed Drones**. Both military analysts and decision makers should be cautious that simply adding infantry will not solve tanks' vulnerabilities on the modern battlefield. Evidence from Ukraine suggests that the ubiquity of drones on the battlefield renders the combined infantry-armour formation less effective than in the past. Drones are hard to detect, making it difficult for infantry-armour formations to find and destroy them. This advantage allows an adversary to ambush an infantry-tank formation before it can defend itself. Thus, successful tank operations in the future will involve not only linking infantry to tanks, but ensuring the attachment of reconnaissance and security (R&S) troops.

Figure 21: A modern Armed Drone.

17. **Targeting Fuel Tankers**. Ukraine managed to limit Russia's use of tanks in 2022 by targeting their vulnerable soft-skinned fuel-supply tankers. Without fuel, even the best tank in the world becomes a stationary artillery piece. For both fuel and maintenance reasons, tanks need to be transported to as close to the battlefield as possible.

18. **R&S Troops**. R&S troops can provide early warning and counter reconnaissance capabilities needed to mitigate the drone's advantage. Together, infantry-tank formations and R&S troops will maintain the tank's lethality at lower echelons and help armored combat power adapt to the changing characteristics of modern warfare.

19. **Blind Spots of Armour**. A tank's hardened armour and high-explosive weaponry allow it to destroy enemy positions with speed, mobility, and certainty. These characteristics help the tank penetrate reinforced battle positions, producing a psychological shock in the adversary's mind. But, where the tank excels in survivability and firepower, it struggles to keep its crew situationally aware. For example, a tank requires its commander to view and designate targets with an optic periscope, and this optic leaves the tank commander vulnerable to blind spots. This vulnerability worsens in combat when the risk of death or injury will be taken place due to blind spots. These circumstances allow an adversary to exploit the tank's vulnerability by hiding in the commander's blind spot and attacking the tank with an antitank guided missile (ATGM) or armed drone.

20. **Use of Tanks by Ukraine to Defend Russian Armour**. Russia's operational tank fleet consists of various modifications of three main types: the T-72, T-80 and T-90. Russia probably has around 2,600 operational tanks. Ukraine can probably field around 600 tanks, mainly T-72s, including undamaged Russian tanks that ran out of fuel during early days of conflict. It seems unlikely that Ukraine will be able to crew and field an effective force of Western tanks before Russia mounts its threatened major offensive in the rest of this year. NATO's offer of 157 third-generation tanks to Ukraine, 129 of which will come later, won't be enough to make a significant difference on the battlefield, but it may help boosting Ukrainian army morale.

Figure 22: A Russian T-72 Tank.

Figure 23: A Russian T-80 Tank.

Figure 24: A Russian T-90 Tank.

21. **Handling Western Tanks by Ukraine Crews**. The extensive debate about the provision of a relatively small number of Western tanks to Ukraine has created the impression in some schools of thought, that the additional armour will be a game-changer. That's unlikely to be the case. Modern main battle tanks are complex pieces of equipment requiring a high level of crew training and expertise to operate effectively. For example, the US training course for the M1 Abrams tanks takes six months to complete. A third-generation Western tank is a world away from the old basic Soviet-era tanks that Ukraine has been accustomed to operating. Hence, the induction of Western tanks without a comprehensive training and practicing in mock-ups with Ukrainian tank crews would eventually going to be repeating the Syrian mistake in Golan Heights during Yom-Kippur War.

Figure 25: A US Army M1 Abrams Tank.

22. **<u>Tank Maintenance Capability to Defend with Tanks in Long Term</u>**. It's not yet clear whether the tanks being provided to Ukraine will be in new condition. Donor militaries tend to get rid of older equipment that is past its use-by date. Donations of large numbers of armoured vehicles might look good politically, but vehicles will be of limited value to Ukraine because it lacks the capability to maintain old Western equipment. Australia has donated 28 M113 armoured personnel carriers, which could fall into that category. What Ukraine wants is new equipment that can be run into the ground with minimal maintenance.

Figure 26: M113 Armoured Personnel Carrier.

23. **Tactical Considerations**. The lessons derived from tactical considerations and changes in tactics and future developments in terms of defence in the Ukraine theatre of war could be enumerated as follows:

a. Russian armour is rarely used for attempts at breakthrough in recent engagements. Instead, armour is largely employed in a fire support function to deliver accurate fire against Ukrainian positions. This means Russians have resorted in to fire support role using Armour due its failures in offensive operations and hence it is very clear that the Russians are capable of only frontal attacks. Hence, Ukraine forces would have to more consider on the front rather than providing flank protection or cover the gaps among defended areas using Armour.

b. The ability of Leopards and other Western tanks to stand off and fire at greater range, and superior armour in comparison with many of the tanks being fielded by Moscow, may give Ukrainians an edge, if employed in numbers. They also have a better ability to operate cross-country in comparison with the lower-clearance Russian tanks and fight effectively at night in prepared positions.

c. Ukrainians would have to plan their fire power concentrate rather than disperse in the whole defended zones due to scarcity of resources. Delivery of Western tanks to Ukraine will be small in numbers; hence employing those with Infantry support could gain advantages. Employment of small number of tanks in security zone (covering force area) would not be wise for Ukraine Armoured Forces due to the mobile nature of Covering Force battle where they can be outnumbered when exposed one to another.

d. Small number of Western tanks delivered in near future will be useful in more limited counter attacks in the defensive framework. They may also be needed extensive camouflage and concealment against Russian Air Force at prepared positions.

e. Having so many different types of tanks coming from different sources and their own different types will necessarily cause maintenance and logistical problems for Ukraine Armoured Forces.

Figure 27: A German ‘Leopard 2 A6’ Tank.

Figure 28: A Formation of highly modernized Russian Air Force.

CONCLUSION

24. Armour, originally conceived as an offensive instrument, turned out to be equally useful on the defence, especially when dug into the ground in “hull-down” positions and deployed with other weapons and field fortifications such as antitank ditches, mines, and barbed wire. Such a combination presented almost insuperable obstacles to the attacker, whose forces would be caught in a maze, cut into penny packets, and lured into killing grounds. Also, as other countries built up their armoured forces in imitation of the Germans, great tank-to-tank battles sometimes took place; but even here the visions of theorists such as J.F.C. Fuller, who had predicted all-tank armies manoeuvring against each other like navies at sea, were seldom if ever realized.

Even in North Africa, with its absolutely open terrain, victory usually went to the side that better knew how to combine armour with other arms such as artillery, antitank artillery, infantry, and engineers. Further, in Gulf Wars with superior Armour of Western powers employed against Saddam's Army or against Al-Qaeda or ISIS in the Middle East later, were not alone deployed. This concept became the order of the day, and evident in the contemporary battlefields in Russia-Ukraine war and it will remain so for decades to come.

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Major Mayura Samarasinghe USP psc of 4 Armoured Regiment enlisted to the Sri Lanka Army on 10 January 2004 to the SLMA Regular Intake 59. He has served as a Troop Leader, Assistant Adjutant, Technical Adjutant and Squadron Second in Command during both Eastern and Northern Humanitarian Operations of the 5th Recc Regiment and as a Squadron Commander of the 4 Armoured Regiment. He also has performed as ADC to Commander Security Forces (WANNI) and later as the ADC to Commander of the Sri Lanka Army, GSO 2 (Training) - 24 Infantry Division, SO 2 - Geo-Political Cell, AHQ and SO 2 at Commander's Secretariat, AHQ. As an instructor he has served as an Officer Instructor at ACTC and Directing Staff at Army War College. Maj Mayura has locally followed Infantry and Armour Young Officers Courses, Junior Staff Course, DSCSC Course and UNSOC Course. In terms of foreign courses, he attended Armour Young Officer's Course at School of Armour and Mechanized Warfare, Pakistan, DSCSC Course – Bangladesh and got qualified as an Armament Instructor from ACC&S, India. He holds a BSc in Military Studies and has earned his MSc in Defence and Strategic Studies from KDU, a Diploma in Diplomacy and World Affairs from BIDTI and MSc in Military Studies from Bangladesh University of Professionals. A keen rider and a driver he enjoys playing badminton. At present Major Mayura Samarasinghe performs duties as the Senior Instructor (Conventional) at Sri Lanka Military Academy, Diyatalawa.

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THANKING NOTE BY THE COMMANDING OFFICER

It is with utmost delight I pen this thanking note down. Inalienability of the professional knowledge and related skills for a military officer need no elaboration. Cavalry Officers traditionally maintain their knack in professionalism guided by the intrinsic regimental culture. As Tankers, Officers of 4 Armoured Regiment should be abreast of the modern trends in Armoured Warfare and technology in order to deliver the best when demanded.

A Unit Symposium will serve two vital purposes. Firstly, it will enhance the academic and conceptual knowledge of officers. Secondly, it will give an opportunity for officers to gain much needed experience and skills in event organizing, academic writing and research presentation.

The 4 Armoured Regiment will go on record in the history as the first ever unit which conducted a symposium in the Sri Lanka Army. It was a real challenge to organize such an event at the unit level and the success was possible due to the contribution of many.

On behalf all Tankers, it is my duty to express our profound gratitude to Major General SWM Fernando WWV RWP RSP VSV USP ndc psc, Colonel Commandant – SLAC, an ardent Tanker himself, for initiating the Unit Symposium concept. His farsighted directions and guidance were a true blessing while organizing this event. I fervently believe these kinds of exercises will further solidify the cavalry legacy as the Colonel Commandant has envisaged.

The academic value of the 4 AR Symposium tremendously increased due the contribution of our speakers and panelists. I wish to convey my utmost appreciation to Brig WASR Wijedasa WWV RSP USP ndc psc and Brig KMPSB Kulatunga RSP ndc psc for delivering the Keynote and Summing up speeches. True Tankers from the core, their words of wisdom will surely add on to the learning experience we all shared.

I am particularly grateful to Lieutenant Colonel IAB Kulatunga psc, Major KMK Samarasinghe USP psc, Major KBSSS Bandara psc and Major PLKM Jayakody psc for their invaluable academic contribution. I dedicated the four subject areas to them with lot of faith and they really did a fantastic job clearly demonstrating that the future of our regiment and the Corps is in safe hands. I also wish to thank our two Session Chairs and panelists for sharing their knowledge.

May I thank all the Council Members who encouraged and guided us, and particularly our distinguished invitees on behalf of the officers of the 4 Armoured Regiment. The Commander Armoured Brigade and the Centre Commandant guided and encouraged us in all stages from the day one of this event. The General Officer Commanding 22 Infantry Division and his staff, Commandant of the School of Logistics and his staff, Commandant of the SLAF Academy and his staff, all brigade commanders of the 22 Infantry Division supported us in numerous ways and needs to be remembered. All senior officers including my fellow commanding officers who are here unreservedly encouraged us all throughout. I thank them all.

It is my duty to thank all former Commanding Officers and retired officers who guided and assisted us in various ways. Last but not the least, there is a special team whom I need to appreciate. The Second in Command and all officers, and the Regimental Sergeant Major and all other ranks; the Tankers fraternity who should get the full credit of organizing this event keeping up the cavalry decorum. Well done and keep it up.

With the knowledge and skills that we gained, let us all dedicate ourselves for the security of our motherland, credibility of the Army, pride of the Corps and esteem of our beloved regiment. Thank you.

Lt Col DMVMR Dissanayake RWP RSP psc
Commanding Officer