



NATIONAL DEFENCE UNIVERSITY-KENYA

Research Project

**Strategising the Use of Drones in Modern Aerial Warfare
for Indian Sub-Continent**

Gp Capt Vijay Kumar Gupta (Reg No. ND 601/0024/2022)

23 Oct 2023

Supervisor: Col (Dr) James Kimuyu, PhD

DISCLAIMER

The information contained in this paper is the result of my Research. The views and/or observations on this issue involved is my own. They do not in any way reflect the official position of the Ministry of Defence or that of National Defence College and the National Defence University-Kenya

DECLARATION

I hereby declare that this research project is entirely my own original work. It has not been presented at any other University.

Group Captain Vijay Kumar Gupta

ND 601/0024/2022

Signature.....

Date

This research project has been submitted for examination with my approval as the officially designated University Supervisor.

Col (Dr) James Kimuyu, PhD

Senior Lecturer, NDU-K

Signature.....

Date

DEDICATION

I wish to dedicate this research project, to both my wife Rohini and Son Vansh, with a deep appreciation for their unwavering support during my NDC and NDU-K course in Kenya. Their love, encouragement, and understanding were my pillars of strength throughout the project, and I could not have done it without them. My wife's support was immeasurable, and I am forever grateful for her sacrifice and selflessness I could not have completed this project without her unwavering support. The love and affection of my son were the source of inspiration that kept me going every day. His smile and laughter gave me the strength to push through, even when the research seemed insurmountable. I hope this project will serve as an inspiration to him, as it represents the value of hard work, dedication, and commitment. I want to express my gratitude for his patience, understanding, and flexibility during my time away. His constant encouragement and support kept me motivated, and I am grateful for his love and understanding. This dedication is a small tribute to the love and support my family gave me during this project. I am honoured and blessed to have my wife and son in my life, and I look forward to sharing many more achievements with them in the future.

With heartfelt gratitude.

ACKNOWLEDGEMENT

I would like to express my heartfelt appreciation to my thesis supervisor, Col (Dr) James Kimuyu, for his invaluable guidance and support throughout the development of this research project. His knowledge, expertise, and guidance have been instrumental in the successful completion of this research project. His insights and suggestions have been invaluable in helping me to refine my research questions, design my methodology, and analyse my data. His dedication, availability, and encouragement have been crucial in keeping me motivated and focused throughout the research process. He provided invaluable feedback and guidance that helped me to refine my arguments and strengthen my writing. I am grateful for his unwavering support, even in the face of unforeseen challenges. His feedback, encouragement, and guidance have been a source of inspiration that kept me going, even when the research seemed insurmountable.

I would also like to express my gratitude to my colleagues for their support during this research project. Their encouragement, feedback, and insights were invaluable in helping me to refine my ideas and strengthen my arguments. Their contribution to this project goes beyond the mere sharing of knowledge; their support and friendship have been invaluable in keeping me motivated and focused throughout the research process. I am fortunate to have worked with such an exceptional group of colleagues, and I am grateful for their contributions to this project.

Sincerely,

Gp Capt VK Gupta

Indian Air Force

TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF ABBREVIATIONS AND ACRONYMS	vii
ABSTRACT	ix
CHAPTER ONE: INTRODUCTION	1
1.0 Introduction.....	1
1.1 Background.....	2
1.2 Statement of the Problem.....	3
1.3 Research Objectives.....	4
1.4 Research Questions.....	5
1.5 Literature Review.....	5
1.5.3 Gaps in the Literature.....	9
1.6 Justification of the Study	11
1.7 Theoretical Framework.....	12
1.8 Research Methodology	13
1.9 Chapter Outline.....	15
CHAPTER TWO: EVOLUTION OF DRONES FOR THE CONDUCT OF MODERN AERIAL WARFARE.....	17
2.0 Introduction.....	17

2.1 Getting the Name Drone	18
2.2 Evolution of Drones.....	19
2.3 Drone Powers of the World	25
2.3.1 Israel.....	26
2.4 Conclusion	41
CHAPTER THREE: ROLE AND TASKS OF MILITARY DRONES IN MODERN AERIAL WARFARE.....	42
3.0 Introduction.....	42
3.1 Roles and Tasks Performed by Drones	43
3.2 Case Study - Armenia-Azerbaijan War	54
3.3 Future Roles of Drones	64
3.4 Conclusion	67
CHAPTER FOUR: STRATEGISING THE USE OF DRONES FOR INDIA.....	69
4.0 Introduction.....	69
4.1 India and Its Neighborhood	70
4.2 Assessment of Combat Power of India’s Neighbours	72
4.3 Strategising Use of Drones by India for Modern Aerial Warfare.....	77
4.4 Conclusion	90
CHAPTER FIVE: CHALLENGES AND OPPORTUNITIES FOR INDIA IN DRONE WARFARE OF THE 21 ST CENTURY: FIELD STUDY.....	92
5.0 Introduction.....	92
5.1 Data Presentation and Analysis	93

5.2 Conclusion	108
CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSION AND	
RECOMMENDATIONS	
6.0 Introduction.....	111
6.1 Summary of Findings.....	111
6.2 Conclusion	113
6.3 Recommendations.....	114
6.4 Recommendations for Further Study	117
REFERENCES.....	118
SURVEY QUESTIONNAIRE.....	123

LIST OF ABBREVIATIONS AND ACRONYMS

AAA	-	Anti-Aircraft-Artillery
AD	-	Air Defence
AFV	-	Armoured Fighting Vehicles
AMDL	-	Aircraft Missile Data Link
AMRAAM	-	Advanced Medium Range Air to Air Missile
BDA	-	Battle Damage Assessment
CCP	-	Chinese Communist Party
CMC	-	Central Military Commission
COMINT	-	Communication Intelligence
CSFO	-	Counter Surface Force operations
DARPA	-	Defense Advanced Research Projects Agency
DEAD	-	Destruction of Enemy Air Defence
DRDO	-	Defence Research and Development Organisation
DT	-	Dynamic Targeting
ECM	-	Electronic Counter Measures
ELINT	-	Electronic Intelligence
FAA	-	Federal Aviation Administration
FATA	-	Federally Administered Tribal Area
GES	-	Ground Exploitation Systems
GPS	-	Global Positioning System
HAL	-	Hindustan Aeronautics Limited
HALE	-	High Altitude Long Endurance
HALSOL	-	High Altitude Solar
IAI	-	Israel Aerospace Industries

IAF	-	Indian Air Force
ICBM	-	Inter Continental Ballistic Missiles
IPR	-	Intellectual Property Rights
ISR	-	Intelligence, Surveillance, and Reconnaissance
LTTE	-	Liberation Tigers of Tamil Eelam
MALE	-	Medium Altitude Long Endurance
MLRS	-	Multiple Launch Rocket Systems
MSME	-	Micro, Small and Medium Enterprises
NAL	-	National Aeronautics Limited
NKAO	-	Nagorno-Karabakh Autonomous Oblast
NSA	-	National Security Agency
PLA	-	People's Liberation Army
PLARF	-	People's Liberation Army Rocket Force
RPV	-	Remotely Piloted Vehicle
SAM	-	Surface to Air Missile
SEAD	-	Suppression of Enemy Air Defence
SWIR	-	Short Wave Infra-Red
TST	-	Time Sensitive Targeting
TUAV	-	Tactical Unmanned Aerial Vehicle
UAV	-	Unmanned Aerial Vehicle

ABSTRACT

Drones have rapidly created a space for themselves in modern aerial warfare in the recent past. In the 21st Century Wars, they have been found to play key roles in creating favourable situations for the victors. They have evolved from under the shadow of manned aircraft and are extremely useful in modern aerial warfare. Many countries have timely invested in this technology and are reaping benefits. These countries include the pioneers of this technology such as Israel and the United States followed by Turkey, China, and Iran among others. Drones are being used in multiple roles by these countries that include ISR, BDA, and Air to Surface attacks. Drones have a lot of scope in the future as they will be used in roles of loyal wingmen, drone swarms, and even the delivery of WMDs. India is an emerging superpower in the South Asia region with the second-largest standing Army, the fifth-largest air force in the world, and an expanding Navy. It is surrounded by hostile neighbours and it needs to ensure that its strong military retains the technological edge. It needs to ensure that in the field of drones, it is at par if not ahead of its neighbours. This research aimed to strategise the use of drones in modern aerial warfare for Indian Subcontinent keeping the threat assessment in mind. Using the Theory of Realism, the study followed a mix of a quantitative and qualitative approach to assess the laid down objectives that included the study of the global evolution of drones, assessment of the roles and tasks that can be performed by drones in modern aerial warfare and analysis of effective employment of drones in various types of military campaigns keeping India at centre stage. The study found that drones have not been adopted doctrinally well, in the Air Power doctrine of IAF, to give the required emphasis on their usage and proper procurement and India lacks the strategic environment for research, development and domestic production of drones for aerial warfare. The study recommended that the Indian Air Force needs to doctrinally adopt drones in various roles for aerial warfare, lay down the specifications and requirements of drones for their procurement and development, and India must create an environment for the indigenous development of these war machines.

Keywords: Drones, Aerial Warfare, Strategise, Indian Sub-Continent, War Machines, Indigenous Development

STRATEGISING THE USE OF DRONES IN MODERN AERIAL WARFARE FOR INDIAN SUB-CONTINENT

CHAPTER ONE: INTRODUCTION

1.0 Introduction

The World's Air Forces are hugely impacted by one characteristic of Air Power called "Sensitivity to Technology." Air arms are technologically sensitive and hence they need to constantly upgrade themselves technologically with the latest equipment along with developing strategies and tactics to suit Aerial Warfare. So far, the air battles have been fought predominantly by manned aircraft capable of performing Air to Air battles along with Air to Ground weapon delivery. However, the contemporary world is seeing increasing use of Drones in various roles in wars and conflicts. Their capability is also being upgraded with each passing day to meet the countermeasures developed against them and to reduce the risk to human life strapped inside the cockpit. Increasingly, more and more roles are being given to Drones in Aerial Warfare which has been demonstrated in the War between Armenia and Azerbaijan in 2020 wherein drones proved to be decisive in achieving victory for Azerbaijan.¹

India has long struggled with a hostile neighbourhood, with several of its neighbouring countries involved in conflicts or tensions with India. The threats range from cross-border terrorism, and insurgency, to border disputes. In this scenario, it has become imperative for India

¹ Dixon, Robyn. "Azerbaijan's Drones Owned the Battlefield in Nagorno-Karabakh — and Showed Future of Warfare." Washington Post, November 11, 2020. https://www.washingtonpost.com/world/europe/nagorno-karabakh-drones-azerbaijan-armenia/2020/11/11/441bcbd2-193d-11eb-8bda-814ca56e138b_story.html.

to focus on modernizing its defense capabilities, including the use of drone warfare. Drones have emerged as a crucial component of modern warfare, allowing for strategic and precision strikes, surveillance, and reconnaissance. By leveraging drone technology, India can enhance its situational awareness, reduce troop casualties, and effectively target and neutralize enemy threats. Therefore, the need of the hour is for India to continue to invest in drone technology and develop a comprehensive drone warfare strategy to deal with the complex security challenges it faces in its hostile neighbourhood. However, how far the use of drones has been strategised for modern aerial warfare by India remains a question to be answered. The aim of this study, therefore, was to strategise the use of drones in modern aerial warfare for Indian Sub-Continent.

1.1 Background

Practically from the beginning of aviation, engineers and scientists have dreamed about and occasionally created airplanes that could be commanded remotely and thus fly unmanned. A string of technological advancements throughout history has made it possible for unmanned aircraft to slowly step out from under the shadow of manned platforms. The military was the major force behind the creation of unmanned vehicles. Even in the early stages of the development of manned air platforms, they could see the possibilities generated by unmanned platforms. Since then, a number of operational factors have also evolved that have sped up the evolution of military drones. The rise of asymmetric warfare and counter-insurgency operations are not the least of these.

With advancements in drone technology, larger platforms could also begin to carry weapons. The twenty-first century has seen rapid advancement in aerial warfare with drones taking the place of manned aircraft to perform some selected roles. The types of asymmetric conflicts that have occurred in Iraq and Afghanistan have acted as catalysts for further

technological advances in the capabilities of unmanned aircraft. America's war on terror saw the use of High-Altitude Long Endurance (HALE) unmanned systems undertaking precision missions in Federally Administered Tribal Area (FATA) and North Waziristan of Pakistan and Afghanistan. The war between Armenia and Azerbaijan, in 2020, witnessed extensive use of armed Drones from the Azeri side tilting the balance in favour of Azerbaijan in record time. This was the first instance when the Unmanned Systems surpassed the effectiveness of other modern equipment and became the decisive factor in the outcome of the conflict. The Russia-Ukraine war, which started in February 2022 and is still ongoing, is also filled with numerous examples of extensive employment of Drones.

The advancement and extensive employment of Drones in the 21st century by some of the nation-states in recent conflicts has left many nations thinking about their existing policy and strategy for the employment of Drones in full-scale conflicts. A clear understanding of positioning drones in full-scale military conflict is either lacking or is in the process of being formulated for most countries, even in the case of a few regional powers. Strategizing drone warfare in the 21st century, thus, needs to be prioritized in order to provide guidelines for the development or procurement of drones for any nation-state.

1.2 Statement of the Problem

Drones have rapidly created a space for themselves in modern warfare in the recent past. In the 21st Century Wars, they have been found to play key roles in creating favorable situations for the victors. Today, their possession is being looked at very critically in assessing the capability of nations to strategise modern aerial warfare, However, many states have not placed adequate impetus on the design, development, and procurement of these systems and thus are lagging in adopting a proactive approach to adapting this technology. This could be severely

detrimental to operations when they engage in war and conflict. There is clearly a lack of strategy to include drones as part of their arsenal to enhance the build-up of formidable force, ensure safety of crew and act as crucial force multipliers in modern complex wars.

India is an emerging superpower in the south Asia region with the second-largest standing army, fifth-largest air force in the world, and an expanding navy. The mighty sub-continent is growing at the fastest pace with the highest growth rate. With an area of 3.3 million square kilometers and a huge population of more than 1.4 billion², with not-so-very friendly neighbors surrounding it, it needs a clear military strategy to safeguard its National Interests and secure its long borders. Drones can play an important role in safeguarding nations and there is a need to define their use in modern aerial warfare. This study seeks to develop a strategy for the Indian Sub-Continent on the use of drones in modern aerial warfare in the 21st century.

1.3 Research Objectives

Based on the background of drones, the problem statement, and the generated research questions, the general and specific research objectives are provided in further paras.

1.3.1 General Objective

“To comprehensively investigate the evolution, applications, and strategic implications of drones in modern aerial warfare, with a specific focus on their role in various military campaigns, positioning India as a central case study.”

² Encyclopedia Britannica. “India | History, Map, Population, Economy, & Facts,” n.d. <https://www.britannica.com/place/India>.

1.3.2 Specific Objectives

- a. To examine the global evolution of various types of drones in the shadow of manned aircraft.
- b. To evaluate the fast-growing employment of drones and assess the roles and tasks that can be performed by drones in modern aerial warfare.
- c. To analyse how drones can effectively be involved in various types of military campaigns keeping India at centre stage.

1.4 Research Questions

Based on the usage of Drones in the current scenario, the problem statement and the objectives, the following research questions emerge:

- a. How have drones evolved and to what extent have various countries adopted the latest and most technologically advanced drones?
- b. What are the roles and tasks that are best suited to drones in modern aerial warfare?
- c. In what manner can a nation like India strategise the use of drones in modern aerial warfare?

1.5 Literature Review

Detailed literature review was carried out with the intent to scan through a wide array of knowledge that exists with regard to the contemporary use of drones in aerial warfare. Drones have been used significantly in various roles that include surveillance & reconnaissance, battle damage assessment, laser range finding, laser spot for guided munition attacks, and most

importantly targeted killing in Counter-Insurgency or Counter-Terrorism roles, especially by American forces. The literature was analysed to identify areas where it substantiated the core arguments of this study, at the same time identifying gaps concerning the objectives of this study. The literature review is covered here and in the subsequent chapters that address each of the objectives and research questions identified in this research.

1.5.1 Evolution of Drones in Global Context

Kaag and Kreps have analysed that as recently as the 1990s, drones were not armed at all. They were utilised only as sensors in the air that assisted mostly the manned missions or guided the land forces, with Predator drones operating in Bosnia, Kosovo, and the no-fly zone in Iraq. The use of drones in combat has increased considerably since the beginning of the 21st century. While only nine drone strikes were executed by the US between 2004 and 2007, the number increased to 295 strikes between 2009 and 2012 in Pakistan alone, resulting in about 2,221 casualties.³ The evolution of drones from unarmed eyes in the sky to remotely operated killing machines with a bird's eye view has been quite fast-paced and has gained prominence within two decades.

Rogers and Hill see the arrival of drones in the world arena as both slow and fast: slow because the essence of developing and employing drones has been around for over a decade at least without becoming widely popular, and fast because technology caught up with the concept somewhere at end of the twentieth century, resulting in rapid expansion in Drone use. Between

³ John Kaag, Sarah Kreps. 2014. *Drone Warfare*. Polity Press.

2002 and 2010, the US military's drone stockpile more than quadrupled, and at the beginning of 2014, more than 70 countries had Drones in some form or another.⁴

According to Frantzman, drone technology can be used to attack nuclear power plants and put civilian airports in danger. The battleground and warfare have transformed from Syria to Libya to Yemen which is hugely attributable to drones. Formerly the domain of a select few militaries, drones are nowadays being produced in Russia, Turkey, China, and smaller nations like Taiwan, which could eventually enter the military drone market. Similar to how Navies switched from using enormous yet vulnerable battleships to smaller, more maneuverable vessels, militaries may soon spend more on drones than tanks and artillery pieces. Drones will be dominantly used to fight current and future battles, and whoever has the most advanced technology will dominate the battlefield.⁵

Slogget believes that the use of pilotless balloons by Austria in 1849 that carried bombs over Venice is nothing less than the use of drones. These balloons installed timing fuses that got operated over the target area releasing the bombs over the target.⁶ His research dives deep into answering numerous questions, such as why the US invested so much money in drone technology? When did that begin? What constraints had to be tackled? What existed there before drone technology? What tasks did drones perform in Afghanistan and Iraq? Had they been successful in operations? What novel developments have been made in drone technology amid offensive operations? and finally, will drones completely take over the Air Forces of the world?

⁴ Ann Rogers, John Hill (2014). *Unmanned: Drone Warfare and Global Security*. Pluto Press.

⁵ Frantzman, S. J. (2021). *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*. Bombardier Books.

⁶ Slogget, Dave. 2015. *Drone Warfare: The development of the unmanned aerial conflict*. Skyhorse Printing Press.

1.5.2 Employment of Drones in Multifaceted Environment

Focusing on the experiences of drone operators, drone attack victims, anti-drone activist groups, human rights activists, international legal experts, journalists, military strategists, and academic specialists, Gusterson investigates the significance of drone warfare from a variety of angles. He explains how drones are altering how battles are fought. They can be employed at the discretion of the commander and engaged in conventional war zones or to execute targeted killing in nations like Yemen and Somalia, where the United States is not formally at war.⁷ He argues that although drones are slow, they are more accurate than traditional bombers and fighter planes, enabling combat with few civilian casualties while keeping pilots out of harm's way.

According to Cortright and Fairhurst, in the last ten years, armed drones have become a cornerstone of the American military's inventory for fighting terrorism. They allow for the precise deployment of lethal force across borders whilst also keeping one's forces safe when combined with access to trustworthy information. It is also possible to minimise injuries to civilians as firepower can be employed with high accuracy. In addition, drones reduce the threshold for carrying out military strikes by doing away with some of the traditional restraints on the use of force, such as the requirement of obtaining political backing for full mobilisation.⁸ Global guidelines for the use of drones are now more important than ever to ensure that their deployment is strategically, morally, and legally sound. This is due to the expansion of drone capabilities across dozens of nations.

⁷ Gusterson, Hugh. 2016. *Drone: Remote Control Warfare*. The MIT Press.

⁸ David Cortright, R. F. (2015). *Drones and the Future of Armed Conflict: Ethical, Legal, and Strategic Implications*. The University Of Chicago Press.

Parks and Kaplan present a new critical paradigm for examining and evaluating the historical, legal, geopolitical, and cultural aspects of drone warfare. They demonstrate how drones generate distinctive ways of visualising the battlefield and enemies while serving as instruments for the exercise of state power. Using a former drone operator's personal account, they also attempt to defend the morality of extrajudicial executions and discuss how US drone strikes in the Horn of Africa influence people's daily lives. The authors also examine how drone warfare affects sovereignty, governance, and social difference; they give accounts of the connections between drone technologies and forms of perception and mediation; and they theorise how drones relate to biopolitics, robotics, automation, and art. *Life in the Age of Drone Warfare* is an interdisciplinary and current book that advances the critical study of drones while enhancing the public discourse on one of our time's most pervasive weapons of conflict.⁹

Rogers and Hill contend that drones are the first fully globalized weaponry, and that unmanned systems are altering not only the course of battles but also the nature of conflict itself. The conventional limitations of time and geography that have historically determined conflict in the international system are eliminated by drone technologies. They take into account the risk that these weapons will become commonplace in international conflict, posing the threat of brand-new, unpredictable, and unaccountable kinds of warfare.¹⁰

1.5.3 Gaps in the Literature

These authors have been able to identify the capabilities that drones can add to any military. They propose the use of drones in all types of conflicts and justify that future wars will

⁹ Lisa Parks, Caren Kaplan. 2017. *Life in the Age of Drone Warfare*. Duke University Press.

¹⁰ Ann Rogers, John Hill (2014). *Unmanned: Drone Warfare and Global Security*. Pluto Press.

be well affected by the inclusion and extensive use of drone technology in all forms of warfare. However, there are certain areas in which these studies have not focused adequately that includes the utilisation of drones in full-scale conflicts, likely roles that drones will take up in the future, and strategising the use of drones in modern aerial warfare for a nation.

The United States is a technologically advanced developed nation was the first one to develop drones worthy of being utilised in various roles including targeted killings. Post 9/11, America's war on terror gained momentum and armed drones like Predator started raining hellfire on terrorists in Pakistan and Afghanistan. Due to such prominence of these drones and the hue and cry generated due to targeted killings with collateral damages, the authors have been much more focused on America's War on Terror and Targeted Killing in their presented work. This reduced focus on the utilisation of drones in full-scale conflicts between nations as the limelight was taken by war between a developed and capable nation and terrorists in hiding or non-state actors.

The authors have also looked very deeply into the accounts of what has been executed by drones with timelines and their usage by the nations operating them. In spurts, where the evolution and development of drones take the attention of the author, the roles that have been executed by drones have been specified. However, the need of specifying the roles and tasks that can be undertaken by drones does not get exhaustively covered. The assessment of roles and tasks in which drones can also be employed in the future finds inadequate emphasis in the literature under consideration.

Though the literature under consideration is the latest on the subject of drones, it misses out on the coverage of drone warfare in the latest wars of Armenia-Azerbaijan and Russia-Ukraine. In the former, drones were utilised to a great extent to tilt the balance of war towards Azerbaijan and an example was set for the world in the field of drones. The latter war is still on

and has not concluded. Therefore, it is well expected that adequate literature concerning the ongoing war may take some time to get published after thorough research. However, the limited information available regarding ongoing operations reveals that there is extensive use of drones by both Russia and Ukraine.

As drones have reached the top gear in recent times and so far nations are still reliant on manned aircraft for most of the aerial warfighting, the literature on the conduct of a full-scale conflict lacks availability. A full-scale conflict first needs to be understood by the author before the utilisation of drones can be suggested and thus it may sometimes be necessary for a specialist in that subject with practical experience to lay down the guidelines.

Finally, the existing literature regarding the utilisation of drones does not take into account the doctrine and strategy by any country as a basis of its operations. The reason may be that the drones are designed and developed for warfighting depending on the need of the hour and the necessity of the mission. Countries like the US, which do not fear a full-scale conflict in their continent are more inclined towards drones that can perform more expeditionary exercises. The study of drones, thus, more often than not has been limited to the expeditionary nature of war wherein surveillance on the far-situated enemy or targeted killing of a terrorist takes much more importance than strategising the use of drones for a full-scale conflict. This provides the gap that this research seeks to address but with a special focus to India.

1.6 Justification of the Study

Past wars, conflicts and experience show that Unmanned aerial vehicles, also known as drones, have had revolutionising effects on war and world politics. Drones allegedly tilt the military balance in favor of the offense, reduce existing asymmetries in military power between major and minor actors, and eliminate close combat from modern battlefields. A lot has been

written about drones in the past, however, the writings are mostly impressed by the targeted killings by American drones in Afghanistan and Pakistan. The capabilities of drones have been discussed in multiple pieces of literature but how they can be utilised in full-scale conflicts is short of need. This is even more critical in their use in the Indian Sub-Continent.

This study will fill seek to fill the gaps by studying drones and the characteristics of warfare tweaked by them. The study will also take into account the case study of the latest Armenia-Azerbaijan war where the explicit use of these machines tilted the balance in favour of the victor. Finally, this study will try to doctrinally absorb the use of drones in modern aerial warfare. The findings of this study will be useful for state actors to strategise the use of drones in modern aerial warfare that cannot be directed by the available literature and most importantly enable India develop drone strategies that will make it a military superpower within the South Asia region.

1.7 Theoretical Framework

This research work is guided by the Realism theory in international relations that views the world as a competitive and anarchic system, where states pursue their self-interests, primarily through the use of military and economic power. Realists believe that states are the primary actors in the international system and that the pursuit of power and security is the driving force behind their behavior. Drones are a means of waging war in military parlance. As drones gain prominence in the arena of warfighting, more and more nations have shown interest in acquiring this technology. The main reason why more and more countries would like to own the latest technology of drones is that they would like to enhance their national security from external threats by the means of enhanced war waging capability. The enhanced war-waging capability will not only ensure the survival of the nation in wartime in the anarchic order of the

competitive environment that continues to exist as the world order but it will also act as a deterrence for another state to take a chance and get involved in conflict with the capable state. The strategy of deterrence is one of the constituents of the theory of realism that emphasizes the competitive and conflictual side of international relations.

The most important thing to understand about Realism is that it is a philosophy that contends that distasteful activities like war are necessary weapons of statecraft in an imperfect world and that leaders must employ them if doing so serves the interests of the country. This makes perfect sense in a society where preserving the state is of utmost importance. After all, if one's state is destroyed by an invasion or falls apart within, then all other political goals lose their practical significance. In the end, states rely on self-help to ensure their security. Powerful, Capable, and latest drones promise leaders of states to act as force multipliers in various roles before, during, and after a conflict and can act as a tool in realising national interests through enhanced national security. Realism, therefore, is the theory that wholly justifies the requirement to strategise the use of drones in modern aerial warfare to efficiently induct them into the military arsenal of the state in question. Thus, the theory of realism in International Relations was utilised in this study.

1.8 Research Methodology

The study applied a mixed-methods research approach, combining qualitative and quantitative methodologies, to comprehensively identify and strategise the use of drones in 21st-century warfare. This approach allows for a multifaceted exploration of the research topic. Primary data collection was a significant component of the research methodology. This included collecting data directly from individuals of the organizations involved in the use of drones in

modern warfare. In addition to primary data, the study utilised secondary data sources such as literature, documents, and case studies to provide context and background information.

Secondary data included Academic Literature, Government Reports and Documents, Case Studies and Historical Archives. Academic literature contributed to the establishment of a theoretical framework, tracing the historical evolution of drones, and examining the theoretical underpinnings of their application in modern warfare. Official documents and government reports served as primary sources for understanding national and international policies related to drones, including legal and ethical considerations, and the strategic importance of drones in military operations. Analysis of recent case studies offered practical examples of how drones have been employed in contemporary conflicts, helping to assess their impact and effectiveness in various operational scenarios. The historical archives provided historical context, aiding in understanding the evolution of drones in warfare and their transition from experimental concepts to operational assets.

Data collection was carried out using a structured questionnaire. The questionnaire was so crafted so as to take the target population through the three specific objectives of the thesis so as to allow them to understand the framework of the research project. Questions were formulated to seek necessary information and the opinion of the involved personnel. The questionnaire was pre-tested to ensure its validity and reliability by requesting the thesis supervisor to undertake the questionnaire. The questionnaire thereafter was distributed over the internet through Google Forms that assisted in automatic collection and primary analysis of data by arranging the answers in a systematic manner.

The ethical considerations taken into account during data collection, included informed consent and data confidentiality. The information was obtained with consent from all participants, ensuring they understand the research's purpose, procedures, and potential risks.

Participants voluntarily agreed to participate and be informed of their right to withdraw at any time. The confidentiality of the participants has been protected by safeguarding their personal information and ensuring that their responses are anonymised in the final report. Also, the privacy of the participants was protected and it was ensured that any information collected does not intrude on their personal lives or reveal sensitive details.

1.9 Chapter Outline

The study is organised into six chapters as outlined below:

- a. Chapter 1 – Introductory chapter covers the background, problem statement, research questions, objectives of the study, literature review, justification of the study, conceptual framework, hypotheses, and methodology of the study.
- b. Chapter 2 – Evolution of Drones for the Conduct of Modern Aerial Warfare. This chapter covers the evolution of drones at a global level under the shadow of manned aircraft and explains how this fast-paced technology is gaining prominence in the execution of the war.
- c. Chapter 3 – Roles and Tasks of Drones in Modern Aerial Warfare – This chapter discourses the roles and tasks in which drones are being employed in aerial warfare as well as the potential they carry to become a force multiplier.
- d. Chapter 4 – Strategising the Use of Drones for India– This chapter studied the possibility of doctrinal absorption of drones for executing various roles in a full-scale conflict as well as secondary roles. The chapter also endeavoured to formulate the strategy for the utilisation of drones with India at centre stage.

- e. Chapter 5 – Challenges and Opportunities for India in Drone Warfare of the 21st Century – This chapter focuses on data presentation, analysis, and findings of the study aimed at answering the research questions.
- f. Chapter 6 – This chapter provides a Summary of Findings, Conclusion, and Recommendations of the Study.

CHAPTER TWO: EVOLUTION OF DRONES FOR THE CONDUCT OF MODERN AERIAL WARFARE

2.0 Introduction

The introduction of drones on the world stage has been a process that has been both gradual and rapid. Initially, the growth has been slow as experiments with the concept have been ongoing for more than a century without it becoming mainstream. However, in the recent past, the growth in the use of unmanned aerial vehicles has been explosive due to increased operational demands, expansive battlefields and the need to minimise battle casualties. The number of drones in the inventory of the United States military increased by a factor of 40 between the years 2002 and 2010, and more than 70 countries presently possess UAVs in some form or other.¹¹ They have also been troublesome because of how they have been used, most notably as weapons of assassination for targeted killings, and because the general public may have a fundamental suspicion of the notion of robotized battle.

The use of drones in various theatres around the world today is a result of the way they have seen their development or conversely their requirement kept on determining the way they needed to be developed. Thus, understanding how these drones developed is extremely important before a country can truly absorb them in its arsenal and profess their use in line with its doctrinal values. This chapter is intended to examine in a detailed manner how these drones developed under the shadow of manned aircraft, and does the usage of this technology constitute a substantial change in how we conduct our global affairs.

¹¹ Ann Rogers. *Unmanned: Drone Warfare and Global Security*.

2.1 Getting the Name Drone

The United States Navy began working on a secret program codenamed "Drone" in the decade before World War II, inspired by military efforts to develop unmanned aircraft. The project was part of a long line of global research in unmanned flight, beginning with aerostat flying in the 18th century and continuing through military tests with air balloons in the 19th century and the construction of airborne torpedoes during World War I. However, Project Drone represents a conceptual beginning in the history of pilotless aircraft, since it was at this time that the name drone began to gain the complex layers of meaning that would eventually lead to the Predator drones deployed in the United States' so-called war on terror. The Americans didn't come up with the codename out of thin air; they appropriated it from a rival British effort that had already gotten off the ground. U.S. Navy Chief of Operations William Standley was inspired to push for the Drone experiment after seeing anti-aircraft training with the Queen Bee in London during the Second Naval Conference in 1935. The Queen Bee was a remote-controlled plane used to test the effectiveness of ship defences against aerial attacks.¹²

The officer-in-charge of Project Drone, Delmar Fahrney, described the discussion that led to the codename in a history of pilotless aircraft and guided missiles he wrote more than three decades later. "It was revealed that the English had called their project 'Queen Bee'; hence, a variety of bug names were considered. It was determined that the name DRONE most accurately described the circumstance in which a released target aircraft was engaged, and the

¹² Chandler, Katherine. 2020. *Unmanning: How Humans, Machines and Media Perform Drone Warfare*. Rutgers University Press.

nomenclature was straightforward. Without more ado, the word was utilised in all oral and written conversations, and it survives to this day.”¹³

2.2 Evolution of Drones

It would be helpful to clarify what we are talking about before we go into the specifics of the history of drones. Before we do that, though, let's get into the broad strokes. The majority of dictionaries agree that an unmanned device that is navigated by remote control or onboard computers is what is meant to be referred to as a drone. Although the phrase may refer to several different things depending on the context, for this study, a drone is an unmanned flying machine that is either controlled remotely or operates totally on its own. In the context of modern technology, an unmanned aircraft is referred to as a drone. A drone is essentially a flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with onboard sensors and Global Positioning System (GPS).¹⁴ Drones have become increasingly popular in recent years as a result of their versatility and affordability.

2.2.1 Earliest Developments

When Austria invaded Venice in 1849 using unmanned balloons filled with explosives, one may argue that this was the first use of the notion of drones. Around two hundred of these incendiary balloons were released above the city of Venice by Austrian soldiers who were conducting a siege of the city at the time. Each balloon carried anything from 11 to 14 kilograms

¹³ Ibid.

¹⁴ IoT Agenda. “What Is a Drone? - Definition from WhatIs.Com,” December 1, 2021. <https://www.techtarget.com/iotagenda/definition/drone>.

of explosives. After being moved into position, the bombs were released from their carrier balloons and fell upon the city below to inflict devastation. An unexpected shift in the wind's direction caused the majority of the balloons to be blown off track, which worked out for the best of the Venetians since just one of the bombs hit its target.¹⁵ The usage of balloons does not exactly satisfy the current definition of drones, particularly military drones, even though this event was very revolutionary in the realm of military technology. Having said that, it is quite intriguing to learn that the fundamental notion of drones was being examined by military experts more than 170 years ago. This was a fascinating discovery. This way of thinking would be the impetus for the advancement of drone technology throughout the course of the next centuries and decades.

2.2.2 World War I

After the start of World War I in 1916, the first aeroplane that did not need a human pilot to fly was created. These pilotless military drones, which were also known as the “*Ruston Proctor Aerial Target*”, made use of a radio guidance system that was invented by the British engineer Archibald Low. Low quickly constructed a pilotless aircraft with the help of a crew of around 30 people that he had hand-picked and it was launched from the back of a truck using compressed air.¹⁶

Not long after this, the United States Army designed and constructed the “*Kettering Bug*”, an aircraft that included gyroscopic controls and was conceived of as an "aerial torpedo." Every "Bug" was hurled from a four-wheeled dolly that rolled down a movable track to achieve

¹⁵ Slogget, Dave. 2015. *Drone Warfare: The development of unmanned aerial conflict*. Skyhorse Printing Press.

¹⁶ Ibid.

maximum distance. "An electrical connection was closed by a control when a certain amount of time had elapsed, which resulted in the engine being turned off. Then, the wings were allowed to be freed, which caused the Bug to fall to the ground. On contact, the 82 kilograms of explosive caused the Bug to explode." The Dayton-Wright Airplane Company was responsible for the construction of perhaps fifty "Bugs," but they arrived too late to participate in any real battle.¹⁷

2.2.3 Post-World War I

After World War I, technical advancements in military drones continued uninterrupted. In the 1930s, the United States Navy started experimenting with radio-controlled pilotless aircraft, which led to the creation of the Curtiss N2C-2 Drone in 1937. The British produced "Queen Bee," a radio-controlled target drone, in 1935, which is also credited with popularizing the name "drone" for radio-controlled unmanned aircraft. The radio plane OQ-2, a remote-controlled model aircraft invented in the 1930s by British actor Reginald Denny and engineer Walter Righter, was the first mass-produced drone product in the United States. During the battle, almost 15,000 drones were built for the military.¹⁸ However, Edward M. Sorensen deserves credit for creating a radio-controlled aircraft that could fly out of sight. He invented an idea that employed a ground terminal to follow the aeroplane's movements. Before this advancement, early RC aircraft could only operate within the controlling pilot's visible range. However, the most important occurrence in terms of drones during World War II was the

¹⁷ Newcome, L. 2004. *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*. Pen & Sword.

¹⁸ Vyas, Kashyap. "A Brief History of Drones: The Remote Controlled Unmanned Aerial Vehicles (UAVs)." *A Brief History of Drones: The Remote Controlled Unmanned Aerial Vehicles (UAVs)*, June 29, 2020. <https://interestingengineering.com/innovation/a-brief-history-of-drones-the-remote-controlled-unmanned-aerial-vehicles-uavs>.

appearance of the German army's V-1 "Doodlebugs." These vessels, outfitted with pulsejets, were the world's first cruise missiles. They were employed in a campaign of "terror bombing" on British cities like London to demoralize the British people. Their guiding system employed a rudimentary autopilot to manage altitude and airspeed; a pair of gyroscopes-controlled yaw and pitch; a magnetic compass-maintained azimuth, and a barometer instrument-controlled altitude. Pressurized air was used to regulate the gyros, rudder, and elevator. Americans then reverse-engineered the technology and created their own pulsejet-powered unmanned aerial drones such as the TD2D-1 Katydid and Curtiss KD2C.¹⁹

2.2.4 Vietnam War

The next significant advancement in drone technology happened during the Vietnam War. This conflict saw the first mass deployment and employment of drones as reconnaissance-specific drones. In addition, according to the Imperial War Museum in London, "drones started to play a variety of new tasks, such as serving as decoys in battle, delivering missiles against fixed targets, and dropping pamphlets for psychological operations." In the late 1950s, the U.S. spy aircraft, the manned SR-71 Blackbird, and spy satellites were still in development and not yet ready for deployment. Specialized drones were required to securely collect intelligence in battle zones. Some types, such as the Ryan 147Bs, did exist, but to retrieve the intelligence they acquired, they had to be towed behind transport planes like C-130s and parachuted into friendly territory.²⁰ The necessity for drones for a variety of military purposes was recognized by a large

¹⁹ Ibid.

²⁰ Chandler, Katherine. 2020. *Unmanning: How Humans, Machines, and Media Perform Drone Warfare*. Rutgers University Press.

number of governments throughout the globe. New drone models got more complex as designers concentrated on increasing their durability and safe operating altitude.

2.2.5 Post-1980s

Even though the United States was successful in achieving a breakthrough in the mass manufacturing and delivery of drones for the military, drones were often seen as unreliable and costly. This viewpoint shifted in 1982, when Israeli troops successfully defeated the Syrian Air Force with the use of unmanned aircraft, sustaining very few casualties in the process. Additionally, in 1980, the United States launched the Pioneer Unmanned Aerial Vehicle (UAV) Program to develop a low-cost drone that could be used for fleet operations. In 1986, the United States of America and Israel collaborated on a project that resulted in the construction of a medium-sized reconnaissance aircraft known as the RQ2 Pioneer.²¹ Additionally, around this period, those who work on developing drones started paying more attention to developing alternate power sources for drones. Solar electricity was one option that immediately came to mind. Because of this, various fascinating drones that are driven by solar energy were invented, such as the AeroVironment HALSOL.²²

2.2.6 1990 to 2010

Miniature and tiny versions of drones were first shown to the public in the year 1990, while the world's first Predator drone was unveiled to the public in the year 2000. With the aid

²¹ Boyle, Michael J. 2020. *The Drone Age: How Drone Technology will Change War and Peace*. Oxford University Press.

²² Frantzman, Seth J. 2021. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*. Bombardier Books.

of this in Afghanistan, both the search for Osama bin Laden and the firing of missiles were successful. In the years that followed, AeroVironment, Inc. developed a wide range of small-scale, fixed-wing surveillance drones. Some of these drones were marketed under brand names like Raven, Wasp, and Puma. Raven is now being used in a variety of countries, and there are tens of thousands of units operating in the field at any one time. The year 2006 was yet another pivotal one in the history of the development of drones. This year was the time when the Federal Aviation Administration (FAA) presented the first commercial drone operator with their permission certificate.²³

2.2.7 Post-2010

This is the golden age for the development and usage of drones. One can see a quantum jump in investments by various countries, not only in military drones but also in the commercial drone market. From surveillance and targeted killing to delivery of goods and services by commercial operators, drones are everywhere and in all strata of life. Their increasing use is a testimony to the fact that our airspace in the future will be filled with these unmanned yet man-controlled flying machines and they will be used in all spheres of life. However, here in this study, it is important to stay stuck to only the military drones, the study of which will pave the way for strategizing their use in modern aerial warfare.

In the current era drones are mostly being improved and put to greater use while taking inspiration from the existing drones. To strategise investment and use of drones by any country especially India, it is now important to analyse how the countries operating the best drones

²³ Vyas, Kashyap. A Brief History of Drones: The Remote Controlled Unmanned Aerial Vehicles (UAVs).

stepped into the area of drone development & usage, what necessitated their use of drones in aerial warfare and how have they gone on investing in this modern technology to gain momentum in the field of drone warfare. In the current scenario, the major drone powers can be counted on fingers. Surprisingly, many countries with good military capability do not adequately feature in this list. However, the time has come that the countries lagging in this technology takes cues from the existing drone powers and move forward.

2.3 Drone Powers of the World

The pioneer in drone development is Israel, a country that also displayed its usage in its wars against Arab countries. The United States has featured maximum due to its Global War on Terror post 9/11 which saw the use of drones in various battlefields of the world trying to curb terrorism.²⁴ China realised the power of drones and has invested heavily in the technology. Turkey is more like a wild card entry that has displayed huge success with its drones in wars like the Armenia-Azerbaijan war and to an extent in the Russo-Ukraine war from Ukraine's side. In the ongoing Russo-Ukraine war, another country that has emerged with its ongoing secret drone program is Iran. Some of its drones are being used by Russia against Ukraine, which has displayed a new different technology and way of usage, and thus Iran seems to gather some limelight in the world of drones. Instead of starting from scratch while strategising the use of drones in modern aerial warfare, it would be prudent to take a cue from these countries and if possible, start from where these nations have already reached in this technology.

²⁴ Scahill, Jeremy. 2016. *The Assassination Complex: Inside the Government's Secret Drone Warfare Program*. Simon & Schuster.

2.3.1 Israel

Israel is a nation situated in Western Asia. It has land borders with Lebanon to the north, Syria to the northeast, Jordan to the east, and Egypt to the southwest. It is located on the southeastern bank of the Mediterranean Sea and the northern shore of the Red Sea. In addition, the Palestinian territories of the West Bank and the Gaza Strip may be found on each side of this region's eastern and western extremities. Israel is 400 Km long in its north-south expanse and is up to a maximum of 100 Km wide, which means that it is a small nation and inherently lacks strategic depth when compared to many other powers of the world. To top it all, it is surrounded by not-so-friendly nations and it has gone to war with its neighboring countries on various occasions that wanted to remove Israel from the world map. Its unfriendly location, lack of strategic territorial depth, and its state of virtually being at war at all times are one of the reasons that force Israel to adopt innovative ways to tackle its enemies. This seems to be the biggest reason why Israel has progressed effectively in defense industries and also it adopted novel ways of using drones in aerial warfare before everyone else including the United States had the wherewithal but not enough push like Israel to operationalize this technology first.

Israel seriously entered the world of drones due to its sobering performance in the 1973 war against Arab nations. This was especially disturbing as Israel had created history in the six-day war in 1967 against the Arab forces by winning the war in a record time of six days, destroying enemy air forces on the ground in overwhelming air operations. In the 1973 war, Israel was reeling from huge losses in the initial days wherein, more than 2,500 Israelis had been killed, 1,000 tanks lost, and more than one hundred aircraft destroyed. For a small country that had been drunk on the success of the 1967 war, when multiple Arab armies had been crushed in

six days, the experience was sobering.²⁵ Israel's primary challenge was gathering real-time intelligence on the adversary. This necessitated not only sending up aircraft to take photographs but also having them concurrently transmit back video.

In 1971, Israel acquired Firebees drones from the US, which were big beasts, weighing more than 2,000 lbs., and had a turbojet engine, flying up to 60,000 feet at 485 miles an hour. In a nutshell, they were rockets with little wings. Their origins were actually as flying targets.²⁶ Thus it would not be incorrect to conclude at this stage that the origin of the Israeli drone program was an American flying decoy. In the 1973 war, Egyptians boasted of a massive army equipped with Soviet Surface to Air Missile Systems. Israel used the Firebees drones to deceive the Radars and Missiles of the Egyptian army reducing the loss of irreplaceable pilots of its manned fighters. These decoys proved effective decoys against the Egyptian SAMs. Israelis also created a combat unit that was made responsible for the operation of these decoys. They also purchased Chukar drones from the US that were also used as decoys in the 1973 operations.²⁷ Both Firebees and Chukar proved very effective flying as decoys. Though most of them were shot down, they had done their job of saving the manned fighters by diverting the attention of SAMs from manned missions in a planned manner.

In reaction to these occurrences, the Israeli company Tadiran created the Mastiff drone. It was capable of live high-resolution video transmission and had a seven-hour flying duration. During that period, the phrase "remotely piloted vehicle" was used to describe it. The aircraft featured a two-cylinder engine and propellers. It was capable of reaching a height of 10,000 feet

²⁵ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

²⁶ Ibid.

²⁷ Ann Rogers. *Unmanned: Drone Warfare and Global Security*.

and a speed of seventy miles per hour with a weight of approximately 150 pounds.²⁸ With the creation of the IAI Scout drone, which had a stabilized camera and a live broadcast link, the Israelis continued to push the bounds of the invention. It would not be incorrect to consider these early Israeli drones to be the ancestor of all future unmanned aerial vehicles. The Scout had a short, angular body that terminated in a sort of snout. It also featured a dual tail or twin tails. The aircraft's fuselage suddenly sprouted several wheels. The Scout had very tiny wings and depended on a rocket for takeoff thrust. This would soon change when the wings were lengthened by two meters, increasing the total length to five meters, and a joystick was added for an external pilot control during takeoffs. In June of 1981, while they were still undergoing testing, a squadron of Scout drones flew into Lebanon to get a video of Syrian air defences that heavily supported Israeli forces in the 1982 Lebanon War.²⁹

During the conflict in Lebanon in 1982, it only took Israel's unmanned aerial vehicles (UAVs) twenty-four hours to wreak havoc on the Syrian air defence system. The Israeli operation, which was given the codename "Peace for Galilee," was initiated to put an end to Palestinian rocket fire into northern Israel. Shlomo Tsach, a former engineer at IAI, recalled how a "drone revolution" took place in the span of only one day.³⁰ After the Israeli Mastiff and Scout drones sent real-time footage of the SAMs and their radar, the Israeli Air Force immediately began working on dismantling the Syrian air defence system. During those twenty-four hours, Israel's multibillion-dollar drone business was officially established, becoming the forerunner of the U.S.'s fascination with unmanned aerial vehicles (drones).

²⁸ Boyle, Michael J. *The Drone Age: How Drone Technology will Change War and Peace*.

²⁹ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

³⁰ *Ibid.*

Though the distance between Lebanon and Israel seems to be short—just 65 kilometres as the crow flies—the land between the two is a maze of twisting roads and hills. Israel was under attack by Palestinian terrorists, and to stop them, it would have to deal with the Syrian army in Lebanon. Twenty-five thousand Syrian soldiers dug in along the Bekaa Valley in central Lebanon representing what should have been an insurmountable barrier. They possessed about eighty missile launchers, in addition to hundreds of radar-guided guns and SA-6 batteries.³¹ However, they were unable to respond quickly enough to the Israeli danger, and their planes were effectively guided to their targets by drones. These new unmanned aircraft systems might be used to steer artillery rockets or designate targets using lasers.

A British military expert determined that Israel's defeat of the Syrians was "tomorrow's war" after drawing parallels between that fight and the Falklands War, which pitted the United Kingdom against Argentina the same year. Israel used a combination of drones, a flying radar dome called an E-2C Hawkeye, and a Boeing 707 for observation and electronic warfare; fighter planes fired Shrike missiles against SAM radars.³² Israel could quickly evaluate the damage from combat and achieve air superiority in a "single afternoon" thanks to the use of drones. Israel used an air-launched decoy to set off the radars with Mastiff drones to locate the SAM locations, with the Scouts acting as a communication link between the drones and the missile operators. Eighteen surface-to-air missiles (SAM) batteries were taken out of commission.³³ As a result, the United States Navy contacted the Americans. The Pioneer drone was developed via a collaboration between IAI and a corporation named Textron in the United States.

³¹ Chandler, Katherine. *Unmanning: How Humans, Machines and Media Perform Drone Warfare*.

³² Ibid.

³³ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

Each Pioneer drone cost approximately \$500,000, and it had a camera that cost \$400,000, and it was able to send back detailed photos that were captured up to 2,000 feet in the air and up to 100 miles distant. The Pioneer was a rocket-launched off-ship lander that could return to a net, making it a direct successor of the Scout. Useful for guiding battleships' one-ton shells in the right direction, it saw action in the Gulf War in 1991. The United States started using Pioneers in 1985, and they helped with naval targeting during the Gulf War.³⁴

Israel and the US further collaborated on a drone that could take off and land at any time of day or night. It should have been capable of electronic surveillance (ELINT) and communications intelligence (COMINT) operations, which fall under the umbrella term of signals intelligence (SIGINT). These requirements led to the development of drones like Hunter, Searcher, and Ranger which were developed by Israeli engineer Dubester and his crew. Tactical unmanned aerial vehicles (TUAVs) and mini-UAVs were among the "families" of drones foreseen by the drone warfare prophets as the number of Israeli drones expanded.³⁵ Rapid development from a single platform led to the current widespread use of multi-mission unmanned platforms, which are equipped with a wide variety of sensors, devices, and antennas. This new discipline also brought its jargon and thus keeping in mind drone operations on the battlefield, the word ISR (Intelligence, Surveillance, and Reconnaissance) was coined.³⁶ By 2002, Israel had mastered the art of drone warfare logging more than 120,000 flight hours, and

³⁴ Ibid.

³⁵ Boyle, Michael J. *The Drone Age: How Drone Technology will Change War and Peace*.

³⁶ Grossman, Nicholas. 2020. *Drones And Terrorism: Asymmetric Warfare And The Threat To Global Security*. Oxford University Press.

marketing this technology to 20 nations.³⁷ A well-strategised use of drones for modern aerial warfare made such a small nation off the coast of the Mediterranean, a drone superpower.

2.3.2 The United States

The success story of drones in the US is quite different when compared to Israel. The US put drones to good use in the Vietnam war for mostly collection of intelligence but only to shelve these potent machines in years to come till Israel made the US realise what they were missing out on, through the Arab-Israel wars. Drone versions had been used by the US in Vietnam to decoy and gather info on surface-to-air missiles. More than 980 of them had been built in the 1960s and 1970s, and 441 were lost in Vietnam. Like many innovative American projects of the space age, they had been abandoned and left to gather dust, with only a few dozen still around by the early 1980s.³⁸ It can be said that the US was the pioneer of drone warfare but they did not pursue the development of these machines adequately bringing a pregnant pause to drone warfare. However, Israel came to the rescue of the US drone program by operationalizing drones in aerial warfare.

When Israel was strategising the use of drones for aerial warfare with the Arab World, the US was using drones for Lockheed Martin's secret development program as aerial targets. It was only in 1983, when terrorists in Lebanon bombed the US Marine barracks in Beirut, that the US reentered the world of military drones.³⁹ At first, the USS New Jersey, an 880-foot World War II-era battleship, was sent to retaliate with its sixteen-inch guns pounding the shore. This

³⁷ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

³⁸ Ibid.

³⁹ Grossman, Nicholas. *Drones And Terrorism: Asymmetric Warfare And The Threat To Global Security*.

was an old-style war when what was needed was more precision to take out terrorists who ran around streets with AK-47 guns. After failing in their efforts with the battleship, the Americans tapped the Israeli company IAI and the Mastiff drones to fight the terrorists. The Israelis and Americans worked with AAI to tweak the drone for naval needs. Soon the US was looking at both the Scout and Mastiff and their descendants the Hunter and Pioneer in many other operations.⁴⁰

The US ejection of Saddam Hussein's massive Iraqi army from Kuwait during the first Gulf War in 1991 showed how useful new drones could be to the world's most powerful army. One Pioneer drone mission had found three Iraqi artillery batteries, several missile launch sites, and an anti-tank battalion in a single mission. The drones were always in the air during the six-week war. When it was over, every field commander wanted them. The Department of Defense claimed that the Pioneer had proved excellent at immediate and responsive intelligence collection in the gulf war.⁴¹

By the mid-1990s, there were nine Pioneer systems deployed, with five drones per system. The US put them on four ships, including the USS Cleveland, an amphibious warship. Army researchers argued they needed to give them to units down to the battalion level. The Marines used Pioneers in Bosnia in 1994 and Kosovo in 1999, flying them from the Ponce De Leon. Meanwhile, the Hunter, built by IAI, was submitted to the US Army to meet its needs for a short-range UAV for reconnaissance missions for corps commanders. The Hunters, named

⁴⁰ Ibid.

⁴¹ Boyle, Michael J. *The Drone Age: How Drone Technology will Change War and Peace.*

RQ-5A, were used in Kosovo as part of Operation Allied Force and eventually flew 30,000 flight hours by 2004.⁴²

It was surprising that the US which first used drones in aerial warfare was using Israeli drones to meet its needs for aerial warfare. However, the US had tried its luck in a multi-billion-dollar drone development program called Aquila, back in the RPV era. Weighing 146 pounds with an almost eleven-foot wingspan, the Aquila drone was supposed to be transported to lift off with a truck and return to a net. It would fly at speeds of up to one hundred miles an hour for several hours, for multiple sorties a day up to twelve miles from the launch site. The flying wing was envisioned as loitering, not necessarily being manually piloted. Using lasers, video, and infrared sensors, it would find targets and transmit information back. The US Defense Advanced Research Projects Agency (DARPA) wanted to develop Aquila for surveillance and targeting.⁴³ The idea of Aquila was to find targets. But unstabilized cameras could only find targets at around 3,000 meters on a road at the time. They wanted it to be able to find tank-sized targets at 1,000 meters with a “fifty percent probability.” Aquila was given the name MQM-105. It soon became evident that the requirements of the contract to jam so many avionics and payloads conflicted with the vehicle’s size. It failed to meet its goals on ninety-eight of 105 test flights. It was supposed to be stealthy and impossible to jam, which also degraded its communications link. The program was a total failure.⁴⁴

The Israelis, by contrast, had built a simple drone for a simple mission. The technological innovations in the 1970s would resurface many years later. Brig. Gen. Hillman Dickinson said

⁴² Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

⁴³ Ibid.

⁴⁴ Boyle, Michael J. *The Drone Age: How Drone Technology will Change War and Peace*.

that the drones could locate targets, conduct “post-strike analysis” and be used for radar, jamming, or even be “flown into a target loaded with an explosive.” He was forward-thinking, arguing they could reduce or eliminate the loss of human life; they were cheap and were not limited by “human frailties” such as fatigue.⁴⁵ The Aquila decade of development finally ended in 1987 after more than a billion dollars. In 1989, the US Army and Navy wanted a short-range drone for surveillance and target acquisition. The IAI Hunter was put forward, along with the McDonnell Douglas Sky Owl. The Sky Owl was sort of a flying box with a twin tail. The Hunter prevailed, designated BQM-155A.⁴⁶

When America did finally build its successful drones, it was due to an Israeli named Abraham Karem. Born in Baghdad, Iraq, he built a drone in his garage in the 1980s, eventually becoming the godfather of the Predator drone. He had come to the US in 1977 from Israel. As Karem, a former IAI employee entered the picture, Israel’s drone revolution was already on the way.⁴⁷ World War II general Henry “Hap” Arnold had once said the next war would be fought by planes with no men in them. Analysts were already forecasting that drones could replace manned aircraft.⁴⁸

The initial drone revolution of the 1980s showcased a new technology. These drones could do surveillance or act as decoys and targets. They could conduct electronic intercepts or electronic war, but there was only a handful of them. They were built on a legacy of similar unmanned vehicles that had been used for spying and other missions. But these decoys, targets,

⁴⁵ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

⁴⁶ Ibid.

⁴⁷ Gusterson, Hugh. 2016. *Drone: Remote Control Warfare*. The MIT Press.

⁴⁸ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

and surveillance assets had never transformed the war. They were tools, and it was by accident that the tools had helped Israel revolutionise the battlefield against the Syrians. The Americans saw this potential and, through some luck and daring, decided to build more of them. This would set the US and Israel on a course to change history and build the kind of technology that had previously only been imagined in futuristic movies.

In its essence, this revolution was about protecting soldiers. Just as knights had put on heavier and heavier armour and trench lines of World War I got deeper and deeper until they became the Maginot Line in World War II, drones were supposed to keep soldiers from harm's way. They were not otherworldly and futuristic at first. They were just a practical, clunky way to solve a problem. That's also how naval ships first got clad in iron and tanks arose. Now we must see how drones broke through and took over war.

2.3.3 China

The history of China's drone program can be traced back to 1950, when the country purchased La-17 drones from Russia and was able to use reverse engineering to develop its own Shenyang BA-5 unmanned aerial vehicle (UAV) (exported version Chang Kong-1 or CK-1). The Nanjing Institute of Aeronautics was responsible for the development of this radio-controlled target drone, which had its first voyage in the year 1966.⁴⁹ The Chinese were once again effective in reverse engineering a United States AQM-34N Firebee drone that they had managed to recover and bring back to their country during the Vietnam War. The Chinese version of the Firebee was first put into service in 1981 under the designation of either the Wu

⁴⁹ Sloggett, Dave. *Drone Warfare: The development of unmanned aerial conflict.*

Zhen 5 (WZ-5) or the Chang Hong 1.⁵⁰ China has made significant progress since then and currently has an operational drone program. It is making significant investments in research and development in order to bring the capabilities of its unmanned systems up to world-class levels. The PLA is equipped with a full-fledged drones infrastructure that is supported by organisational capabilities.

In the framework of the People's Liberation Army's (PLA) efforts to modernize its forces, drones have been seen as an important kind of weapon system that may both bolster the PLA's claims to maritime territory and strengthen its standing in the international arms market. Drones have been identified by a significant number of academics and military experts as an essential component of the People's Liberation Army's (PLA) modernization effort for the purpose of attaining its objectives of near sea protection, force projection, and intelligitized modernization. The modernization of the People's Liberation Army (PLA), which includes robust civil-military integration, has been a driving force behind the rapid advancement of the People's Republic of China's (PRC) drone program in recent years.⁵¹

2.3.4 Turkey

Turkey has become a global leader in the drone industry in the recent past. Only the United States, Israel, and China are in a position to build, employ, and sell armed drones on a large scale, but in recent years Turkey has joined that exclusive club. It has also developed novel strategies for using the inexpensive Bayraktar TB-2 armed drone to achieve overmatch by

⁵⁰ Ann Rogers, John Hill. *Unmanned: Drone Warfare and Global Security*. Pluto Press.

⁵¹ Slogget, Dave. *Drone Warfare: The development of unmanned aerial conflict*.

prioritising number over quality on a variety of battlefields.⁵² Turkey's novel employment of drone squadrons as a substitute for an air force in conventional conflict has offered a strategy for middle-sized states to adopt, leading to the purchase of similar cost-effective weapons from Turkey by other such powers, including Ukraine, Poland, and Azerbaijan. This strategy is likely to be adopted by other middle-sized countries with constrained military expenditures, altering the character of local wars and perhaps throwing off the calculations of bigger, watching states.⁵³

The development of drones is part of a larger endeavor that goes back to the 1990s when Turkey began its modernization and strategic change to become self-reliant in the military sector. In the 1990s, the Turkish military started a \$150 billion, 30-year military modernization program, of which \$60 billion was earmarked for ground forces. With this aim, the Turkish military sector underwent a strategic shift in the 2000s toward self-sufficiency.⁵⁴ In the past, Turkey met all of its military requirements via imports; but, during the last two decades, Turkey has made it a top goal to minimise its reliance on imported weaponry and become more competitive in the defense sector. Recent initiatives include the national combat aircraft project, the national combat ship, the national armed drone program, and the national helicopter program. In addition, efforts are being made to develop indigenous missile and rocket systems, battleships, and a great deal more. These expenditures and efforts over the last two decades have finally begun to yield fruit as Turkey has become a significant drone power in the world, with

⁵² Kaya, Karen. 2022. *Turkey as a Drone Superpower: A Case Study of a Mid-Size PowerDriving the Operational Environment*. Foreign Perspective, Foreign Military Studies Office.

⁵³ Ozdemir, Gloria Shkurti. 2022. "Conceptualising the Rise of Turkiye as a Drone Power." *Strategic Papers: Arab Centre for Research & Policy Studies*, September 19: 12.

⁵⁴ Kaya, Karen. *Turkey as a Drone Superpower: A Case Study of a Mid-Size PowerDriving the Operational Environment*.

its Bayraktar armed drones being employed in a variety of aerial conflicts throughout the globe and exported to many nations.

2.3.5 Iran

Iran has made space in this study as a surprise as one expects mostly well-developed countries to be winning the race in drone development. Iran has never been slow to absorb new technologies, despite the fact that it has not traditionally been an innovator in the field of technological development. For instance, Iran was one of the first nations outside of the United States and Europe to embrace telegraphy. It laid its first lines less than ten years after the discovery of telegraphy, which was a significant amount of time before several European countries did the same.⁵⁵ In the latter part of the 20th century, the Islamic revolution, the Iran-Iraq war, and a variety of international sanctions imposed by the United States and the United Nations wreaked havoc on the Iranian armed forces. Iranian leaders, who were no longer able to afford expensive platforms to stay up with competing Gulf Cooperation Council military, tried to capitalize on low-cost, indigenous alternatives as well as asymmetrical techniques. It was against this background that Iran first started conducting research and development on Drones.⁵⁶ In 1985, Iran successfully launched the Mohajer-1, and the following year, it started conducting experiments with the Ababil-1.⁵⁷ It was used for both monitoring Iraqi activity and positions behind the trenches reminiscent of those employed in World War I, which served as

⁵⁵ Rubin, Michael. "A Short History of the Iranian Drone Program." American Enterprise Institute, 2020. <http://www.jstor.org/stable/resrep26682>.

⁵⁶ Ibid.

⁵⁷ Beerli, Tal. 2021. *Iran's UAV Army: A Global Threat*. Alma Research and Education Centre.

the front line. Thus, Iran can be easily considered as one of the earliest investors in drone technology.

Iranian companies continue to be responsible for a significant portion of the drones manufacture. Even though Iranian authorities were heard discussing publicly in 1990 the possibility of updating the Ababil, Iran's Drone program remained relatively consistent and relied on just a number of variants. This started to change in 2009 when Iran built the Karrar prototype and then soon presented numerous new drone platforms. This was the beginning of the transition. Drones like the Mohajer and Saeqeh are produced by Qods Aeronautics Industries, while the Ababil is manufactured by Iran Aircraft Manufacturing Industrial Company.⁵⁸ Despite the fact that Iran may make drones via businesses associated with the commercial arm of the Islamic Revolutionary Guards Corps (IRGC), the country looks to be reliant on technology manufactured elsewhere. Israeli officials, for example, have stated that the Ayoub drone, which attempted to infiltrate the airspace above Israel's nuclear complex at Dimona, was manufactured by the German company Siemens and Bockstiegel and purchased by an IRGC front company. This information was provided by Israeli officials. It indicates that the Star Holding Group, which is affiliated with Hezbollah, is also engaged in the creation of drones and the purchasing of components.⁵⁹

Additionally, Iran has attempted to circumvent the restrictions in order to get materials for the production of lightweight motors. In 2008, the State Department of the United States issued a warning that Qods Aviation was attempting to obtain lightweight German engines for

⁵⁸ Ibid.

⁵⁹ Fars News Agency. 2021. "The Iranian Drone Threat." *United Against Nuclear Iran*, April: 51.

use in the Iranian drone program by using French intermediaries as a middleman. The United States Embassy in Berlin hastened to issue a *démarche* to German authorities informing them of the activities being undertaken by Iran. In 2013, German authorities accused a German Iranian dual citizen and an Iranian man of the suspected unlawful sale of 61 aircraft engines to be used in Iran's drone program. The engines were allegedly intended for use in Iran's ballistic missile development. In a similar vein, the United States District Court for the District of Columbia accused an Australian man named David Levick and his firm, ICM Components, of conspiring to sell drones and other forms of technology to Iran.⁶⁰

One thing is evident, despite the fact that it is unknown how the Iranian military has been successful in manufacturing and acquiring drones: the military has formidable weaponry. Although there is a gap between the capabilities that have been declared and those that really exist, the Iranian military has started making regular use of drones for the purposes of surveillance and assault, both within and outside of Iran's borders. Iranian officials claim to have produced even more models, but some of them seem to be more aspirational than genuine. Today, various components of the Iranian military fly approximately a dozen distinct drone types, and several of those models have three or four versions. Drones such as Ababil, Fotros, Hamaseh, Kaman, Karrar, Kian, Miraj, Mohajer, Yasir, etc. are only a few examples of the more well-known models that Iranian authorities have shown off in their media or permitted to be shot during military drills.⁶¹

⁶⁰ Beerli, Tal. *Iran's UAV Army: A Global Threat*.

⁶¹ Rubin, Michael. "A Short History of the Iranian Drone Program."

2.4 Conclusion

The evolution of drones has been slow in the initial years of the history of military aviation. However, in the last few decades, drone development programs have moved forward at an unprecedented pace and in recent conflicts, drones are being used rampantly. The evolution of drones has mostly been guided by the necessity of having an unmanned platform flying in threatened airspace to avoid bringing one's soldiers in harm's way. However, many countries brought novelty in bringing their use to another level with the help of innovation and imagination. Countries that assessed and preempted the potential of these flying machines invested heavily in their development and now are reaching a position to reap the benefits of having these potent platforms on their side. The success story of various countries' drone programs gives an insight into the ways the use of drones can be strategised for contemporary and future aerial warfare. In the coming chapters, the study of roles performed by drones and their usage will further open the doors to making useful strategies for drone development and employment for countries lagging in this race.

CHAPTER THREE: ROLE AND TASKS OF MILITARY DRONES IN MODERN AERIAL WARFARE

3.0 Introduction

Modern warfare is largely different from the old wars and is highly technologically sensitive. It implies that both sides involved in combat try their best to acquire and use the most technologically advanced weapons to win over the other side. This is one of the reasons why all-powerful militaries across the globe try to maintain the most modern Air Forces to enjoy the might of Air Power in any battle. Notably, on many occasions maintaining a highly capable Air Force has had a deterrent effect on the enemy allowing nations to win a War without ever fighting it. The manned fighters have been at the apex of every capable Air Force always ready to take the fight into the enemy territory. Even the Naval Air element situated on the high seas has always been looked at as a power centre that plays a vital role in power projection by any Nation. These manned aircraft perform many roles, from ISR, Air Defence, Ground Attack, etc., to strategic bombing and nuclear attacks. It would not be incorrect to say that these aircraft largely decide the outcome of the air War in particular and the conflict in general.

In the 21st Century, militaries and especially Air Forces have realised the capability of Drones in Military warfare. This Century is witnessing unprecedented growth in this sector and is consistently increasing at a pace never seen before. Countries like Israel, Turkey, and also Iran that invested in this Technology early are now reaping the benefits of being drone powers. They have been employing these unmanned machines in various Roles like ISR, BDA, Ground Attack, etc. with plans to use them further in many other Roles in the future. Thus, Drones are constantly making and enlarging their space on the battlefield being capable of performing many Roles.

3.1 Roles and Tasks Performed by Drones

Military Drones have been there in the battlefield for some time. A few countries with a good vision of this Technology initiated this race and more joined in later decades. However, there are still many countries with capable militaries that are yet to properly strategize the use of these potent machines in Modern Aerial Warfare. Gaining their existence as pilotless Aerial targets, these machines have come a long way and are now performing multiple Roles in Air battles with the capability to further expand. Before one could strategize their use in Modern Aerial Warfare, it is prudent to look at the Roles these Drones are essentially being used in.

3.1.1 Intelligence, Surveillance, and Reconnaissance (ISR)

Intelligence, Surveillance, and Reconnaissance (ISR), is often executed in several aspects of the military. ISR is an integrated intelligence and operations mechanism that can be characterized as the coordinated acquisition, refining, and provision of accurate, relevant, and timely data and information to aid a commander's decision-making methodology. This is done in order to provide the commander with the information and intelligence they need to make decisions. The majority of land, sea, air and space installations play crucial roles in the gathering of intelligence, surveillance, and reconnaissance (ISR), which is necessary to assure the success of operations. Images captured by optical, radar, or infrared sensors, as well as electronic signals, are all different types of data that may be gathered by ISR systems. Satellites, drones, manned aircraft, specialized ground, sea, or space-based equipment, and human intelligence teams are the many techniques by which this data might be acquired. It is essential to have accurate data from ISR in order to have excellent information about the risks posed by the adversary and improve the efficiency of military operations. The need for capabilities related

to ISR has only grown in recent years as a direct result of the continual development of technology.⁶²

A significant number of drones are only employed in the performance of intelligence, surveillance, and reconnaissance (ISR) tasks. They vary from the Global Hawk, which has a wingspan that is bigger than that of a Boeing 737 aircraft, to nano-helicopters that weigh just a few grams, and everything in between. Even at the level of the smallest patrol, many soldiers from industrialized countries now have direct exposure to some kind of entirely devoted aerial reconnaissance. These small drones grant access for surveillance and reconnaissance to areas that were previously unreachable for such operations. It is possible for even the tiniest warships to carry extremely effective drones like the Scan-Eagle, which may provide commanders with continual aerial observation. Drones hold the potential of ensuring efficient coverage at sea. The enhancement of stealth, speed and independence should result in increased levels of fighting ability and even decreased rates of imposition.⁶³

An ISR drone can be simply considered an aerial vehicle that is carrying sensor systems. It is the instrument that is used to operate the sensor in the air, provide power to it, and perform tasks with it. Because there is such a large selection of vehicles accessible today, it would seem that ISR is constrained more by the creativity and ingenuity of humans than it is by the technology itself. The capacity to prolong operations, collect information that was previously unknown or inaccessible, and keep soldiers out of harm's way is the foundation for why drones are better fit for tasks that are tedious, squalid, and hazardous. Drones, in contrast to humans,

⁶² Haivision. "Intelligence, Surveillance, Reconnaissance (ISR)." Accessed November 25, 2022. <https://www.haivision.com/resources/streaming-video-definitions/isr-intelligence-surveillance-reconnaissance/>.

⁶³ Ann Rogers, John Hill. *Unmanned: Drone Warfare and Global Security*.

do not experience boredom or fatigue, do not get distracted, and need just a little amount of training. The fact that drones can move around in three dimensions is only one facet of their potential susceptibility. The still image or video cameras that are frequently mounted to drones provide a live connection back to their operators and allow drones to be employed as manoeuvrable real-time eyes in the skies. Drones may also be used to monitor areas on the ground. They produce a high-value target for malevolent third parties as a result of the visual and geographical information that they carry and give for themselves.⁶⁴

The discipline of remote sensing is where many of the strategies and methods that are used in contemporary technology can be traced back to. From pigeons to balloons to airplanes to satellites to drones, remote sensing has come a long way from its beginnings as an effort by humans to observe and gather information about phenomena that are located at a distance. Now, space-based systems for information gathering, command and control, and aerial surveillance are being combined with aerial drones. This area of research has enabled significant advancements in military mobility, assault, and defense, as well as in civilian surveying and development, as well as the flexibility to go anywhere in the globe.⁶⁵

Since September 11, 2001, the need for ISR capabilities has rapidly shifted from the capacity to image a military station or a huge piece of equipment like a tank, to the more challenging necessity of locating individuals or small groups of people. The requirements for reconnaissance in the past were more strategic in nature, whereas the requirements for reconnaissance in today's world are extremely tactical in nature, requiring an increased level of

⁶⁴ Nichols, R. K. et al. UAS Intelligence, Surveillance and Reconnaissance (ISR) – Unmanned Aircraft Systems in the Cyber Domain. Accessed November 25, 2022. <https://kstatelibraries.pressbooks.pub/unmannedaircraftsystems/chapter/chapter-10-uas-intelligence-surveillance-and-reconnaissance-isr/>.

⁶⁵ Ibid.

perseverance and the ability, in so many instances, to recognize human individuals in the area of interest. In recent times, the outstanding capabilities of the shortwave infrared (SWIR) technique have made SWIR the "Next Generation" of imaging technology for surface, aerial, and space technology. Many methods have been used and suggested, but in recent years, SWIR has become the "Next Generation" of imaging technology.⁶⁶

3.1.2 Battle Damage Assessment (BDA)

Battle damage assessment, often known as BDA, is an estimate of the amount of damage that was caused by the use of destructive or nondestructive military force. In other words, the appraisal of the battle damage. The estimation of the amount of damage that will occur as a consequence of the use of military action, whether it be deadly or non-lethal, against a certain target is known as the Damage Assessment (DA). Battle damage assessment is consisting of actual damage assessment, functional damage assessment, and target system analysis. The concept of battle damage assessment is applicable to the use of any and all kinds of weapon systems in the context of military operations.⁶⁷

Battle Damage Assessment is an extension of Intelligence, Surveillance, and Reconnaissance. The difference between the two is that ISR is executed to create intelligence regarding the enemy's vital installations so that targets may be decided based on the input. It is

⁶⁶ SWIR For Intelligence & Surveillance (ISR) | Sensors Unlimited. "SWIR For Intelligence & Surveillance (ISR) | Sensors Unlimited," n.d. <https://www.sensorsinc.com/applications/military/swir-for-isr>.

⁶⁷ Inc., US Legal. "Battle Damage Assessment (Military Law) Law and Legal Definition | USLegal, Inc." Battle Damage Assessment (Military Law) Law and Legal Definition | USLegal, Inc. Accessed November 25, 2022. <https://definitions.uslegal.com/b/battle-damage-assessment-military-law/>.

an exercise undertaken before the attack phase by any Air Force. On the other hand, Battle Damage Assessment is an exercise that is undertaken after the attack phase is over. This exercise aims to assess the extent of damage received by the designated target for attack and to make a decision whether another attack is needed on the target or has been adequately addressed by the attack undertaken.

BDA requires positioning of the sensor system in the Tactical Battlefield Area that can undertake discernable photography of the attacked target and downlink it to the Ground Installation. The process must ensure that in real time the military commander can decide to send the attack once again on the target or focus on the next target system based on the achievement of desired damage to the target. To execute this task, drones again find themselves in a suitable spot as BDA is normally required to be done by a single platform and sending a single manned fighter for this task is not suitable keeping in mind the possible reinforcement by the enemy of the target system, especially by anti-aircraft equipment. Losing a manned aircraft, or so to say a pilot for the execution of a BDA mission is grossly unnecessary. On the other hand, though it is not desirable, losing a drone to enemy fire during a BDA mission is less risky and costly than losing a manned fighter.

3.1.3 Targeted Killing

Although terrorism and counterterrorism are the most common contexts in which targeted killing are used and discussed, this is not the only setting in which it is used. The word refers to a broader category of behaviors, one of which is the use of deadly force against individuals who are not believed to be terrorists. Targeted killing is one of the numerous expressions that are routinely used to describe either national or international politics; nevertheless, there is no definition of targeted killing that is generally recognized. Its current

definition came about as a result of real-world use, and the phrase is not yet included in any major encyclopedias. In recent years, use of the phrase has become more common. This appears to be the case primarily as a result of Israel's policy of targeted killing during the second Intifada, which began in September 2000, and the United States administration's use of this practice in its fight against terrorism, also known as the so-called "Global War on Terror," which was the United States' reaction after 9/11. Both of these policies seem to have contributed to the current situation.⁶⁸

The practice of targeted killing began with Israel's response to the al-Aqsa intifada in September 2000. The intifada began as a series of violent protests over Israeli prime minister Ariel Sharon's visit to the al-Aqsa mosque but escalated into a general protest over Israel's occupation of the West Bank and Gaza. Facing growing unrest and suicide attacks, Israel began to use helicopters and manned aircraft to launch attacks against militant Palestinian groups in the Occupied Territories. Over the period 2000–2005, Israeli airstrikes killed over 203 Palestinian militants and 114 civilians.⁶⁹ The rapid advance of drone technology had begun during this time to make targeted killings in places like Afghanistan feasible, if not easy, for the United States. The Israeli targeted killings had been conducted by manned aircraft, supported by drones, and launched at targets that were only a few miles away in the Occupied Territories. However, the United States was to conduct these strikes in Afghanistan which was nearly half a world away from the US mainland.

The famous Predator drone of the US was mostly being used in the ISR role till the time the US felt the need to use it for targeted killings of terrorists. By January 2001, the United

⁶⁸ Goppel Anna. 2013. *Killing Terrorists: A Moral and Legal Analysis*. De Gruyter

⁶⁹ Boyle, Michael J. *Drones And Terrorism: Asymmetric Warfare And The Threat To Global Security*.

States had managed to get around the technical difficulties of affixing Hellfire missiles to Predator drones and began to test them on dummy targets in the Nevada desert.⁷⁰ The Bush administration at this time was still not sure of going ahead with targeted killings on foreign territories. However, the attack on US soil on 9/11 was an event that ensured the commencement of targeted killings by the US in the name of the Global War on Terror that started soon after 9/11. The first US-targeted killing of Sinan al-Harithi, a prominent al Qaeda leader in Yemen occurred in November 2002. He was tracked down in the deserts of Yemen through a combination of human intelligence, aerial surveillance by Predator drones, and efforts by the National Security Agency (NSA) to track his cell phone use.⁷¹ He was targeted with a Predator drone that fired a salvo of Hellfire missiles to take out the wanted terrorist. After this, there was no looking back for the US and it executed innumerable attacks in various countries like Afghanistan, Pakistan, Yemen, Somalia, Iraq, Syria, etc. on the alleged terrorists.

Having gone through the examples of targeted killings undertaken by Israel and the US, it may seem that targeted killings are meant to be executed against terrorists as surgical operations and they may not form part of the modern aerial warfare that this research is focused on. However, in an ongoing battle between two states targeted killing may still be performed. They are very effective against Dynamic Targets (DT) and Time-Sensitive Targets (TST) that appear on the battlefield either dynamically or for a limited time.⁷² A good example of a Time Sensitive Target is the on-field military commander of the enemy forces, whose presence needs

⁷⁰ Ibid.

⁷¹ Edward Wong, "Hacking U.S. Secrets, China Pushes for Drones," New York Times, 20 September 2013.

⁷² Laird, Robbin. "The Strategic Shift and Dynamic Targeting: Meeting the Challenge - Second Line of Defense." Second Line of Defense, May 28, 2020. <https://sldinfo.com/2020/05/the-strategic-shift-and-dynamic-targeting-meeting-the-challenge/>.

to be established and who needs to be located with the help of an accurate ISR cycle conducted with the help of Surveillance drones. Thereafter, an attack on the field leadership and their killing is bound to have a devastating effect on the fighting enemy forces that witness the execution of their commander.

3.1.4 Air-to-Ground Strikes by Armed Drones

The use of armed drones to attack ground targets is the latest inclusion of capability in the evolution of drones. Although, in World War II, the arming of drones was tried to deliver bombs and missiles by both Axis and Allied powers, however, it had not succeeded the way it was thought of. The real usage of armed drones came into being in 2001 when the US succeeded in arming its MQ-1 Predator drones. Whilst the testing of the firing of Hellfire missiles was still on, the US went through a life-changing event of 9/11.⁷³ This forced the US to use its armed drones to conduct its Global War on Terror. Since then, the weapon carriage capability of drones worldwide has continued to increase with many other nations like China, Turkey, and Iran joining the race to develop lethal unmanned systems.

Notably, Turkey's Bayraktar TB-2 drones were utilised in Syria by Turkey and they also proved decisive in the 2020 war between Armenia and Azerbaijan. Azeri side extensively used these drones in the Counter Surface Force role creating a huge impact on Armenian forces and achieving a decisive victory.⁷⁴ The use of drones for air-to-ground attacks thus is in place for both targeted killings in counter-terrorism operations against nonstate actors as well as for the

⁷³ Scahill, Jeremy. *The Assassination Complex: Inside the Government's Secret Drone Warfare Program*.

⁷⁴ Dixon, Robyn. "Azerbaijan's Drones Owned the Battlefield in Nagorno-Karabakh — and Showed Future of Warfare."

conduct of Counter Surface Force Operations against an enemy state in conflict. Broadly, these attacks can be classified into the Destruction of Enemy Air Defence (DEAD) operations and Counter Surface Force operations (CSFO).

3.1.4.1 Destruction/ Suppression of Enemy Air Defence (DEAD/ SEAD)

The early 1970s were a pivotal decade that marked a significant turning point in the annals of air combat history. During the early stages of the Arab-Israeli War in 1973, Syria and Egypt achieved success in imposing "air denial" on the Israeli Air Force by successfully dominating the skies over the Golan Heights and Sinai with an integrated network of surface-to-air missiles (SAMs) and Anti-Aircraft-Artillery (AAA). This resulted in the Israeli Air Force being unable to carry out missions over those regions. Over four percent of Israeli forces were killed, wounded, or captured during the first three days of the conflict. Because the casualties were so severe, Israel was forced to temporarily halt its offensive over the Golan Heights until the SAMs and AAA had been rendered ineffective by Electronic Counter Measures (ECM) and/or physical assaults.⁷⁵ During this conflict, the significance of electronic warfare and the requirement for specialized aircraft and weapons to suppress, degrade, or destroy adversary ground-based air defences came into clear focus. Both of these factors were necessary to ensure victory.

An action that neutralizes eliminates, or temporally weakens enemy air defence systems in a given region by using either physical assault or electronic warfare is referred to as DEAD

⁷⁵ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

(hard kill) /SEAD (soft kill).⁷⁶ DEAD/ SEAD has the potential to greatly cut down on losses and assist in maintaining offensive air action against an adversary who has a robust air defence network. It takes a considerable amount of specialized equipment, strategies, and strategies, as well as training. Radars and other forms of sensors, surface-to-air missiles, anti-aircraft artillery installations, and communication networks and nodes are examples of potential targets for an assault. Electronic Intelligence (ELINT), Communications Intelligence (COMINT), and other methods of intelligence gathering would all play an important part in the process. In order to produce results, the inherent weaknesses that are present in each individual component of the AD system would need to be identified and targeted.

Drones can be used for the destruction of sensors as well as shooters. Undefended sensors are easy to destroy once they are located through ISR, with the help of drones that can carry air-to-surface missiles and have an onboard sensor that can locate and track these radars. EW and surveillance radars are also big and static to semi-mobile which means they do not change their location frequently.⁷⁷ The best weapon to attack these radars is laser-guided weapons as the size of the radars is not very big and needs to be destroyed with the help of a guided weapon. Thus, it is recommended to use drones armed with laser-guided weapons for the destruction of the sensor network of the enemy's AD system.

The shooter component that involves long to short-range surface-to-air missiles and AD guns is capable of defending itself. The components that can be targeted are the missile tracking radars, missile launchers, and gun positions. These targets require drones that can operate in the kill zones of these missiles and guns while being able to shoot at the targets. Thus, it would be

⁷⁶ Northrop Grumman. "The Need for SEAD / DEAD," n.d. <https://www.northropgrumman.com/what-we-do/advanced-weapons/the-need-for-sead-dead>.

⁷⁷ Ibid.

prudent to develop stealth drones with conformal carriage of air-to-surface missiles.⁷⁸ The stealthy drones may not be detected by the surveillance and tracking radars of the SAMs and AD guns and thus are likely to be more successful in their missions. The biggest advantage here is that even if these drones are detected and shot down by the SAMs or AD guns, no human life will be lost in the bargain.

3.1.4.2 Counter Surface Force Operations (CSFO)

The strategic objective of the counter-surface force operation is to deny the opponent of the military might necessary to occupy, govern, or exploit land or maritime space. This will be accomplished by denying the enemy access to the necessary military resources. It is possible to discourage, confine, neutralize, or destroy the enemy's army and/or navy by the deployment of air power in conjunction with friendly surface forces. These campaigns mostly involve all types of targeting that need to be executed on ground forces within the land or in the sea. Thus, it includes missions like Air Interdiction, Maritime Strikes, and Anti-Shipping operations that nearly encompass all operations required to be undertaken in a full-bore conflict situation between two capable states.⁷⁹

With the advent of armed drones in the 21st century, it started becoming possible for militaries to fit small caliber on these weapons. At first, a limited number of weapons could be integrated onto the drones, however, nations like the US and China have built drones like Global Hawk and Chang Hong series drones respectively, that are capable of carrying a large arsenal

⁷⁸ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

⁷⁹ Indian Air Force. 2012. *Doctrine of the Indian Air Force*. New Delhi, India: Directorate of Operations IEW, IAF.

of weapons on them and have a very long loiter time of more than 80 hours.⁸⁰ These drones are also capable of flying at a very high altitude and thus are very potent platforms for the execution of ground attack missions. The latest examples of ground attack missions by drones can be found in the 2020 war between Armenia and Azerbaijan where Azerbaijan used armed drones to achieve a decisive victory over Armenian forces. The current war between Russia and Ukraine is also employing drone technology to inflict damage on each other which is turning out to be a force multiplier.⁸¹ The use of drones in these two wars shall be studied in this chapter to understand the extent to which drones are being employed in modern wars.

3.2 Case Study - Armenia-Azerbaijan War

The 21st century can be accredited for ushering in an era of unprecedented drone warfare. While in the previous century, drones were being used by only a few countries like Israel and the United States, this century has seen multiple new players like Turkey, Iran, Pakistan, Russia, and India, investing and employing drones in modern aerial warfare. The effective introduction of armed drones is the achievement of this century while simultaneously surveillance drones have seen a major boost to their technology. The quest to understand the ever-growing market and usage of these drones in the current century will remain incomplete without studying the latest wars of this century. In all the 21st-century wars, drones have been most effective in

⁸⁰ Edward Wong, "Hacking U.S. Secrets, China Pushes for Drones," New York Times, 20 September 2013

⁸¹ González, Roberto J. "Drones over Ukraine: What the War Means for the Future of Remotely Piloted Aircraft in Combat." The Conversation, February 23, 2023. <http://theconversation.com/drones-over-ukraine-what-the-war-means-for-the-future-of-remotely-piloted-aircraft-in-combat-197612>.

achieving a decisive victory in the Armenia-Azerbaijan war of 2020 and hence it would be prudent to learn a few lessons from it.

The dispute over Nagorno-Karabakh has been going on for longer than any other in post-Soviet Eurasia. In 1988, ethnic Armenians residing in Nagorno-Karabakh made a demand for the Soviet Republic of Azerbaijan to transfer the territory that was then known as the Nagorno-Karabakh Autonomous Oblast (NKAO) to Armenia. As a result of the disintegration of the Soviet Union, tensions eventually led to full-scale war. When hostilities were finally brought to an end in 1994, Armenian troops had either full or partial control over Nagorno-Karabakh and seven of the neighboring districts. More than a million people had been compelled to leave their homes: Azerbaijanis fled Armenia, Nagorno-Karabakh, and the nearby areas, while Armenians evacuated their homes in Azerbaijan. Both groups were displaced as a result of the conflict.⁸²

From 1994 to 2020, periodic violent episodes, such as the employment of attack drones and heavy weapons on the front lines as well as the actions of special operations troops, highlighted the ever-present potential that war may restart. Four days of heavy combat along the line of separation in April 2016 rattled the area, killed hundreds of people on both sides, and foretold what was to come. The conflict lasted for four days. The barrier finally gave way in September of 2020, and on the 27th of the same month, full-scale warfare was commenced. A ceasefire that was arranged by the Russian Federation on November 10 brought an end to a violent armed war that had been going on for the previous six weeks. Despite the fact that the agreement did not result in a peace that was unambiguous and permanent, it did put an end to the worst combat that the area had seen in over three decades, with over 7,000 military personnel

⁸² The Nagorno-Karabakh Conflict: A Visual Explainer | Crisis Group. “The Nagorno-Karabakh Conflict: A Visual Explainer,” October 26, 2020. <https://www.crisisgroup.org/content/nagorno-karabakh-conflict-visual-explainer>.

and around 170 civilian deaths and numerous additional injured.⁸³ As a result of the deal, Azerbaijan has retaken complete control of the seven districts bordering Nagorno-Karabakh that Armenian troops had controlled since the end of the conflict that occurred there before. In addition to this, it controls a sizeable portion of the Nagorno-Karabakh territory. The remaining territory is under the control of self-proclaimed local administrations despite being monitored by a Russian peacekeeping force.

It is of the utmost importance to have a solid understanding of who stood where among the many fighting groups and the general profile of the weaponry. Strange allies were found on both sides of the conflict between the two states. The majority of Christian countries, as well as Western Europe, were on Armenia's side throughout this conflict. Armenia is a Christian country. Nevertheless, its most reliable ally was Russia, with whom it has a friendship treaty and which maintains a military installation on its territory. In addition to this, it enjoyed the covert backing of the Shia country of Iran. Turkey, a Muslim country that is mostly Sunni, was Azerbaijan's most important ally, in contrast to Azerbaijan, which was predominately Shia. Azerbaijan also enjoyed the backing of Israel, a country with whom it has had longstanding connections because of Israel's reliance on the oil produced in Azerbaijan. Israel has been providing them with a variety of military hardware, such as the IAI's Harop, which are kamikaze drones also known as the "Harpy." These are miniature suicide drones, or "Loiter munitions," as they are referred to in certain nations. Their frames are constructed with explosives already installed.

A huge number of Turkey's most advanced drones, known as TB2 Bayraktars, were among the items that Azerbaijan had acquired from Turkey. With the exception of its control

⁸³ Ibid.

and communication range, the TB2 belongs to the same category as the Chai Hong CH4 from China and the Predator from the United States. A drill involving the use of drones was perfected by Azerbaijani and Turkish military forces during an exercise that took place in August of 2020 and was jointly led by the two countries.

During the first three weeks of the war, most of the fighting took place on the ground between the opposing troops, and the conflict quickly reached a standstill. The Azeri troops were able to shift the tide of the war in their favor when they made two adjustments to the tactics they were using. First, they deployed drones as their main method of devastation, and second, they attacked the road that leads from Nagorno-Karabakh to Armenia, which is where the majority of the supplies and logistics were being sent to the front lines.⁸⁴ Both of these shifts ended up being very detrimental to the Armenian army. Precise targeting was causing the battlefields to shrink, and there were also deaths within the combat troops. At the same time, loitering munitions, known as the Harpy, was attacking and destroying important bridges on the route leading from Armenia, which was creating a huge obstacle for reinforcements arriving from Armenia.⁸⁵

As the conflict proceeded, more and more drones were used. The Armenian defenses were alarmed by an AN2 variation of an old aircraft that had been transformed into a drone and flew toward the enemy areas. This caused the Armenian defenses to fear that a drone assault was about to occur. The adversary was fooled into activating its surveillance and Air Defense (AD) radars in order to locate and track the hostile flying objects when they were really fooled

⁸⁴ Military Strategy Magazine. "Drones in the Nagorno-Karabakh War: Analyzing the Data - Military Strategy Magazine," n.d. <https://www.militarystrategymagazine.com/article/drones-in-the-nagorno-karabakh-war-analyzing-the-data/>.

⁸⁵ Ibid.

by the decoy. As soon as the radars began functioning, the Harpies that were waiting in the higher altitudes swooped completely destroyed the active radars, which deprived the defenses of an effective radar cover. It made it possible for the larger drones, such as the Turkish TB2, to release their fatal cargoes on other combat forces, such as tanks, AFVs (Armoured Fighting Vehicles), artillery pieces and rocket launchers, and missile sites. When the most heavily fortified targets were destroyed, the Harpy was used to kill the infantry men who were seated in trenches.⁸⁶ The strategy consisted of systematically destroying air defense and observation radars in order to achieve the objective. It is possible that not all of this is applicable everywhere. Even though the Armenians were aware of the existence of drones on the battlefields, they were unable to destroy the drones with their outdated Soviet military equipment, which consisted of radars and anti-aircraft weapons.

It was obvious that although the Azeris had modernized their armament, the Armenian troops were still using outdated equipment, which made them defenseless in the face of the catastrophic firepower that was directed at them. The final blow was dealt to the Armenians when the soldier in the trench was eliminated with pinpoint accuracy.⁸⁷ As a result, the troops of the Armenian army felt demoralized and powerless. The standards of camouflage and concealment used by the Armenian battle formations were a much to be desired, and when seen from above, they were all exposed and vulnerable to attack. The lowlands that are located in the southern portion of Nagorno Karabakh provided the Azerbaijanis with the ideal terrain for ambushing and executing the Armenians. The Azeris advanced their offensive operations from the south and made it all the way to the strategically important town of Shusha. The Armenian

⁸⁶ IISS. “Learning the Lessons of Nagorno-Karabakh the Russian Way,” n.d. <https://web-opti-prod.iiss.org/online-analysis/online-analysis/2021/03/lessons-of-nagorno-karabakh/>.

⁸⁷ Ibid.

side also made use of Russian drones to inflict damage, but their contribution to the overall conflict was not significant enough to turn the tide of the fight. As soon as the Azeris reached Shusha, the Armenians launched their catapult. At that point, there were just 24 kilometers (about 15 miles) between the Azeri troops and the capital city, and the Azeris controlled the heights around Stepanakert.

There are indeed a lot of things that the Azeri troops accomplished well that contributed to their winning this battle. To begin, ever since the fight that lasted for four days in 2016, the Azerbaijanis had spent billions of dollars annually on equipping themselves. They purchased the smart ammunition from Israel, as well as the 'Harpys' and 'TB2 Bayraktar drones' from Turkey. In addition, during August and September of 2020, they participated in a training exercise with the Turkish army to gain experience with the strategic use of the TB2s.⁸⁸ During the war, Armenians alleged that Turkish military personnel were responsible for organising and operating the drone attacks. The Azerbaijani troops were successful in their use of the drones, regardless of who was operating them.⁸⁹

Second, early on in the conflict, the Azeris came to the realisation that it would be difficult to win the proximity combat until the distance combat had been decisively won. As a direct result of this, the Azeris employed drones and loitering munitions in order to disrupt the supply lines and demolish the important bridges that were located on the road leading

⁸⁸ Mad Scientist Laboratory. "317. Top Attack: Lessons Learned from the Second Nagorno-Karabakh War | Mad Scientist Laboratory," April 1, 2021. <https://madsciblog.tradoc.army.mil/317-top-attack-lessons-learned-from-the-second-nagorno-karabakh-war/>.

⁸⁹ Ibid.

from Armenia to Nagorno Karabakh. As soon as the combat in the distance was lost, the Armenian troops that were in touch with the enemy ran out of reserves and crucial supplies.⁹⁰

Thirdly, they were able to collaborate their weaponry for devastation by making use of decoy drones as well as sensors situated both on the ground and in the air. The argument made concerning the AN 2 has already been discussed; moreover, targeting infantry foot columns first using the thermal imaging systems of the TB2 and then deploying the Multiple Launch Rocket Systems (MLRS) to rain down fire had a devastating impact. The application of Harpy on soldiers in the fortifications had a tremendously demoralizing impact on the field troops of the Armenian force, which contributed to the army's overall loss of momentum.⁹¹

The strategies used by Azerbaijan should serve as a model for how to make use of drones. The battlefield circumstances that existed in between Azeris and the Armenians were characteristic of the South Caucasian region and may not have been true to other locations. Nevertheless, lessons must be extrapolated or evaluated with care. In addition, none of these countries has a sizable military to speak of. The notion that Armenia has never needed to employ its air force is a statement that speaks volumes. First, they had a limited air force, and second, they lost a Su-25K, which is a fighter aircraft, early on in the conflict, which prevented them from using any more air power. Both of these factors together made it impossible for them to deploy air power. In addition, the two armies were using weapons and equipment that were on opposite extremes of the spectrum of technological sophistication. Whereas the Azeris were

⁹⁰ IISS. "Learning the Lessons of Nagorno-Karabakh the Russian Way,".

⁹¹ Armed drone makes a huge impact in Africa | Times Aerospace. "Armed Drone Makes a Huge Impact in Africa | Times Aerospace," n.d. <https://www.timesaerospace.aero/features/defence/armed-drone-makes-a-huge-impact-in-africa#:~:text=Renewed%20hostilities%20between%20Armenia%20and,platform%20against%20Armenian%20ground%20forces.>

using cutting-edge weapons from the year 2020 and beyond, the Armenians were forced to battle with Soviet-era technology from the 1970s and 1980s. It's possible that two feuding neighbors don't have such a mismatch in their relationship.⁹²

At this juncture, it is essential to draw some conclusions about what this conflict has taught us. To begin, battle in the 21st century would be very dangerous and devastating; armies would thus need sufficient reserves to deal with the inevitable fatalities. Second, it is impossible for any army to defeat modern weaponry by using weapon systems from an earlier generation of technology.⁹³ To effectively counter a newly developed weapon, a sophisticated weapon system is required. To provide a further explanation of this point, drones have very little radar signature. As a result, it was difficult to track them down using the antiquated air defence radars designed in the Soviet manner. Armenian military needed layered air defence systems in order to successfully intercept the Azerbaijani drones. If air defence sensors had been placed at varied distances, this would have ensured that any item trying to penetrate the defences would have to overcome many levels of opposition before reaching its intended target. A defence with a single layer, such as the one the Armenians deployed, was ineffective.

Thirdly, combine the two previous strategies with the prospect of launching a large-scale drone assault on a restricted front in order to gain a bridgehead and accomplish a breakout. During their invasion in the Southern area, the Azerbaijani troops used a similar strategy. A large number of drones were not used since the circumstances did not call for a swarm;

⁹² Mad Scientist Laboratory. "317. Top Attack: Lessons Learned from the Second Nagorno-Karabakh War | Mad Scientist Laboratory,".

⁹³ Ibid.

nonetheless, it is not possible to rule out the potential of using a large number of drones in a hypothetical future.⁹⁴

Fourthly, any kind of weapon system would function more effectively in a networked environment rather than in a mode that operates independently. This is not a new finding, but it was put to the test and validated throughout this conflict. The use of one group of drones as ears and eyes and another set of drones for destruction proved to be the deciding factor. At the commencement of the attack in the Southeast, the Azeri troops severed all communication lines arising out of the Nagorno Karabakh area to Armenia.⁹⁵ This is an intriguing fact that is not as well-known as it should be since it is a less common occurrence. As a consequence, all of the Armenian command and control systems were disabled, and they were unable to communicate with their headquarters located outside of Nagorno Karabakh throughout the crucial part of the conflict; this ultimately led to their defeat. It has been shown beyond a reasonable doubt that the loss of command and control during combat may be a factor that decides the outcome.

Fifthly, it will never be nighttime in a contemporary battlefield because there is no need for it. The night marks the beginning of a new day. Drones may be equipped with cameras that have extremely good night vision. They are able to detect & fire, and as a result, even though humans have a natural inclination that tells them they are safer in the dark, the fact is that they are more susceptible. Infantrymen, who are often the forces stationed on open terrain, are the most defenseless group on the battlefield. Therefore, there is no alternative to having strong combat discipline, which includes hiding, dispersion, and camouflage. One of the most important things that can be learned from this conflict is the need for concealment at all times.

⁹⁴ IISS. “Learning the Lessons of Nagorno-Karabakh the Russian Way,”.

⁹⁵ Ibid.

Last but not least, there will always be an ever-increasing necessity for the military forces to continue to refine and update their prevalent tactics and pander to the transformation in the enemy's layout of battle. This is something that must be done in order to keep up with the constantly shifting nature of the battlefield. The Armenians did not acknowledge the shift in the capabilities of the Azerbaijani troops⁹⁶ and so did not adapt their training to account for the new environment. It was the reason they lost the war.

The war between Azerbaijan and Armenia marked the beginning of a new era for the application of aerial weaponry in the context of tactical battlefields thanks to the deployment of drones. It has caused militaries all around the globe to go into overdrive, returning to the drawing table in order to reevaluate their defensive systems against an aerial foe. It has shed light on the possibility of the existence of a great many additional weapon systems that have not yet been evaluated on active battlefields. A significant implication may be drawn for India from this. Its neighbours to the east and west both have access to drones, and both of those neighbours are next to it. The capabilities of China's CH4 and CH5 drones are now on par with those of the United States. The CH5 and the US Reaper belong to the same kind of aircraft. Additionally, China has created the Kamikaze drone, which is known as the CH 901.⁹⁷ As the militaries worldwide and also in the neighbourhood rush towards gathering this new technology, India also needs to strategise the use of drones for modern aerial warfare and be ready for any eventuality that can be faced in the future.

⁹⁶ Mad Scientist Laboratory. "317. Top Attack: Lessons Learned from the Second Nagorno-Karabakh War | Mad Scientist Laboratory,".

⁹⁷ Drone Industry Insights. "China Drone Market Report 2019-2024 – Drone Industry Insights," n.d. <https://droneii.com/product/chinese-drone-market-report>.

3.3 Future Roles of Drones

The arguments regarding the use of drones in military conflicts in this chapter and the extensive use seen in the Armenia-Azerbaijan war give a clear indication that their usage will continue to increase in the future. As this technology keeps gaining impetus, drones will keep improving in all aspects of capability and thus, more and more roles will be executed by them. There are already a few future roles in which the development of drones is being undertaken. The aim of this study is not only to assess the current usage of drones in military warfare but also to strategise their use for future conflicts and it would not be possible to do it without first assessing the emerging technology and then strategising it for future wars. Some of the future technologies of drones are discussed in subsequent paragraphs.

3.3.1 Unmanned Aerial Combat Vehicle

In the 20th century, drones were essentially being used in the unmanned aerial target role and ISR role. The beginning of the 21st century saw the use of drones in the air-to-ground attack role that has now been adopted by various nations. As the development of drones continues in these roles, now it is expected that the lead nations that are the drone superpowers would want the drones to get into aerial combat with other drones and manned aircraft. These drones must be capable of carrying air-to-air missiles in their arsenal and should have the capability of carrying an Air Interception radar with an Aircraft Missile Data Link (AMDL) for the guidance of missiles post-launch.

The Defense Advanced Research Projects Agency (DARPA) is a research and development agency that is part of the United States Department of Defense. In the year 2020, DARPA awarded contracts for design work on its LongShot program to General Atomics, Lockheed Martin, and Northrop Grumman. The LongShot program is a revolutionary new air-

launched drone that is intended to eliminate enemy aircraft at extreme ranges. LongShot would be carried either externally by fighters or inside by bombers depending on the situation. The LongShot will be launched from a great distance, which will keep the aircraft that is launching it out of harm's way. Once it reaches the target location, it will fire its missiles against the enemy aircraft that are there. Because of its powerful jet engines, the Long Shot could go far further than a conventional air-to-air missile. The drone would then weigh more than two thousand pounds and have a range of approximately 600 miles. It will be able to carry a payload of one thousand pounds, including the AIM-120 AMRAAM (Advanced Medium Range Air to Air Missile) Beyond Visual Range missiles.⁹⁸

3.3.2 Loyal Wingman

One of the premier examples of what artificial intelligence would bring the unmanned world was embodied in the concept of the “loyal wingman,” a drone that would fly alongside a manned aircraft as a kind of Robin to his Batman. Loyal Wingman is the latest concept in drone technology that is peeping into the future of drone warfare. It is a futuristic system and is likely to be developed by countries developing sixth-generation aircraft. Its design would include a flying machine that would not only know how to fly alongside, without crashing into, another plane, but also sponge up data, help with targeting and surveillance, and remove some of the burdens that the primary manned plane would normally have. In combat, it might even be sacrificed or sent on the most dangerous missions, enabling that “standoff” capability that

⁹⁸ Hambling, David. “DARPA Starts Work On LongShot Air-To-Air Combat Drone.” Forbes, February 9, 2021. <https://www.forbes.com/sites/davidhambling/2021/02/09/darpa-starts-work-on-longshot-air-to-air-combat-drone/>.

drones helped with.⁹⁹ All in all, the loyal wingman will be available to the crew of a manned fighter for the execution of tasks in the air that would be risky and thus it would be better to use an unmanned vehicle for it so that even if it is shot, no lives will be lost.

3.3.3 Swarm Drones

A drone swarm is a group of micro-UAVs, flying together in coordination, exhibiting meaningful behaviour as a group, toward accomplishing a mission. A swarm has two fundamental functions. Firstly, a large no of drones strikes at an adversary from multiple directions, in coordination with each other. Secondly, maintain a communications network within the swarm, to coordinate their operations, to act autonomously.¹⁰⁰ These drones are simple to produce, are autonomous, and can communicate with each other for resolution.

The technology of drone swarms has the possibility of bringing about significant benefits in the not-too-distant future. It would seem that the Western world is already aware of this since they are investing significant resources into the investigation of this technological advancement. The fact that the technology is being shown at events and employed by the military suggests that it has already attained a certain level of legitimacy. Swarms of drones might be especially beneficial in urban warfare and counterterrorist operations since they could be flown within buildings to search for and eliminate concealed terrorists without putting the lives of troops in unnecessary danger. The usage of swarms might also be of tremendous use in jungle warfare, especially in the process of locating concealed terrorists and engaging them in combat without

⁹⁹ Frantzman, Seth J. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*.

¹⁰⁰ Col RC Srikanth, "UAV Swarms", War College Journal, December 2014

endangering the rest of their troops. If they were utilised in covert strike operations against enemies during times of peace, it would be impossible to determine who was responsible for the deaths that resulted. Swarms also would make it simpler to carry out surgical attacks by allowing drones to take the place of human operators.

It is possible that in the future, small clusters of networked drones may dramatically alter the way that armed units' function. Future swarms of small drones might be capable of carrying electronic warfare jammers, emitters that mimic the signals of larger aircraft, equipment that is capable of conducting cyberattacks, or other systems to confuse or overwhelm an opponent's defences in advance of or while they are engaged in a more complex operation. It is becoming more obvious that the next generation of aerial warfare will make extensive use of network-centric autonomy and unmanned aerial systems.¹⁰¹ The recent assault by the terrorist organisation Amass on Russian soldiers in Syria has brought to light the very real risk that tiny unmanned aircraft are increasingly posing, even when in the control of non-state actors.

3.4 Conclusion

The military conflicts of the 21st century have seen an unprecedented rise in the use of drones. Apart from the Armenia-Azerbaijan war, there are other operations like Op Iraqi Freedom, Turkey's air operations in Syria, and the Russia-Ukraine war to name a few, that have seen extensive use of unmanned aerial systems. The roles that are being performed by drones and the potential this technology carries will surely ensure that the demand for these systems continues to increase. The question here arises as to how a nation should pursue the design

¹⁰¹ Ibid.

development, procurement, and employment of these lethal systems that have the capability to act as force multipliers. However, this would be based on many aspects like an assessed threat to a nation from its adversaries, the military strength of its enemies, and the terrain in which its forces are likely to fight. This leaves several possibilities for their future. Combining them with manned aircraft is one vision. Using them as a separate “drone force” is another. A multi-layered drone approach is a third option, integrating them into the operations of all branches of the military. Using them in massive swarms as a disposable weapon system to achieve dominance is the fourth concept. Finally, it does not matter what strategies a nation employs for the use of drones, one thing is for sure is that these drones are going to bring huge changes in modern warfare of the future.

CHAPTER FOUR: STRATEGISING THE USE OF DRONES FOR INDIA

"The art of war teaches us to rely not on the likelihood of the enemy's not coming, but on our readiness to receive him; not on the chance of his not attacking, but rather on the fact that we have made our position unassailable." ~ Sun Tzu

4.0 Introduction

One of the major shortcomings of preparation for war is training for future wars by training for the previous war. There is a need to understand that the future won't look the same as yesterday. It's like training doctors using the wrong patient pool. Getting things right using drones, boils down to answering a key question: "What is the vision and doctrine that brings it together?"¹⁰² This is one big question not only in the case of drones but also for any other equipment that must be integrated into the arsenal of a force. Thus, this chapter is mostly a concentration on the vision and the doctrine that would bring drones to the battlefield in the most effective manner.

In the preceding chapter, it was discussed that the bigger question is how a nation should pursue the design development, procurement, and employment of these lethal systems that can act as force multipliers. And this would be based on many aspects like an assessed threat to a nation from its adversaries, the military strength of its enemies, and the terrain in which its forces are likely to fight. This leaves several possibilities for their future for including drones in the military arsenal. Apart from this, it is also to be decided how to use these machines in war.

¹⁰² Frantzman, Seth J. 2021. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*. Bombardier Books.

Combining these modern machines with manned aircraft is one vision. Using them as a separate “drone force” is another. A multi-layered drone approach is a third option, integrating them into the operations of all branches of the military. Using them in massive swarms as a disposable weapon system to achieve dominance is the fourth concept.

India is a country that has followed the non-alignment policy with major powers of the world. It is due to this reason that India shares good relations with both major power blocs of the world without allying with them. It also shares good relations with countries that do not have good relations with the major power blocs, like Iran. It shares good relations with Israel while it has formed bridges with the Arab world too. Ironically, even after such good relations with most countries of the world, India faces critical challenges in neighborhoods and unfortunately, these challenges are multiplied as India faces competent militaries on both the eastern and western front. The only chance to survive in such a neighborhood is to stay militarily competent and ready for the next war and not the previous war as discussed earlier. Thus, when it comes to using drones on the battlefield, India needs to strategise their inclusion and usage in the Indian military with adequate thought toward existing and emerging threats.

4.1 India and Its Neighborhood

Strategising the use of drones for India would not be easy as India will not be easy as India lives in a very unique neighborhood. A definition of what exactly constitutes India's neighborhood must be established before any discussion of India's ties to its immediate neighbors can begin. Before answering this question, one should think about either India's physical or strategic neighbors. Beginning with the Straits of Hormuz and ending at the Straits of Malacca, the first one would encompass the whole region. Before 1947, India's western boundary extended all the way to the Persian Gulf. This was cut in half when the nation was

partitioned into two countries. Since India also occupies the Andaman and Nicobar Islands, Indian frontiers are effectively stretched to the other choke point in the east.¹⁰³

If one were to examine just geographical closeness when determining who India's neighbors are, then Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka, and the Maldives would make up the vast majority of India's neighbors. Considering Pakistan's illegal annexation of Jammu and Kashmir's northern regions, India has every reason to see Afghanistan as a neighbor even if it is not a direct physical neighbor at the current moment. China is now our closest geographic neighbor because of its occupation of Tibet.¹⁰⁴ India's relationship with the world's most prominent rising power is tainted by the ongoing border conflict with China, which is a major roadblock to India's foreign policy. The impact China has had on India's relationships with its South Asian neighbors has not helped. That's why many people in India worry most about China. When it comes to Asia and the rest of the globe, China's growing might has already begun to affect India's standing.

Out of all the neighbors, India does not have friendly relations with China and Pakistan and these two neighbors have been all-weather allies owing to the presence of a common reason between them. India has been at war against Pakistan on numerous occasions since its independence in 1947. Notably, India has been able to win these wars and has kept Pakistan at bay. It has also been responsible for the liberation and formation of Bangladesh in 1971.¹⁰⁵ Apart from this, the threat of terrorism looms continuously from Pakistan and India has been the victim

¹⁰³ Sibal, Kanwal. "India and Its Neighbours - Indian Defence Review." India and its neighbours - Indian Defence Review. Accessed February 5, 2023. <http://www.indiandefencereview.com/interviews/india-and-its-neighbours/>.

¹⁰⁴ Ibid.

¹⁰⁵ Ganguly, Sumit. "Why the India-Pakistan Rivalry Endures." Foreign Policy, December 11, 2022. <https://foreignpolicy.com/2022/12/11/india-pakistan-complex-rivalry-mohan-conflict-politics/>.

of regular state-sponsored terrorism from Pakistan. The age-old history of India and Pakistan, the matter of the disputed area of Pakistan-occupied Kashmir, and regular interference of Pakistan in India through cease-fire violations and state-sponsored terrorism have ensured that India will continue to face threats from Pakistan both now and in the future.

Unlike Pakistan, India has fought with China only once, in 1962. This was caused by border disputes in the Northern region and the North Eastern region. China had an upper hand in this war against India. Apart from that, there have been unarmed border skirmishes between India and China with many lives lost from both sides after escalated skirmishes between the two sides in the northern sector of India. The two sides also faced a standoff near India, Bhutan, and Tibet border in the area called Doklam in 2017. The reason was an extension of road infrastructure by the Chinese side in the disputed area of Doklam which is also claimed by Bhutan and is yet to be resolved between Bhutan and China. These recent escalations between China and India are a testimony to the fact that India will continue to face threats from China.

4.2 Assessment of Combat Power of India's Neighbours

The seventh largest nation in the world, India is surrounded by multiple countries. However, it needs to be prepared against mainly two countries in the neighborhood, China and Pakistan. Notably, these two countries are also the countries in the region that have the inclination and reason to maintain reasonable combat power. China is a fast-emerging superpower and boasts of a defense budget of US\$ 290 billion in 2022 which is nearly 1.6% of its GDP.¹⁰⁶ The defense budget of Pakistan was nearly 2.1% of its GDP in 2022-23 and

¹⁰⁶ Jash, Amrita. "China's 2022 Defense Budget: Behind the Numbers." Jamestown, April 29, 2022. <https://jamestown.org/program/chinas-2022-defense-budget-behind-the-numbers/>.

amounted to approximately US\$ 11 billion.¹⁰⁷ In comparison, India announced a defense budget of US\$ 72 billion in Feb 2023 amounting to nearly 2.57% of GDP.¹⁰⁸ Compared to the combined threat from China and Pakistan, the Indian defense budget looks modest and thus it needs a sound strategy combined with the available equipment to ensure success in any kind of conflict. To bring drones into this debate, it is necessary at this juncture to quickly take a look at the military power of these two countries.

4.2.1 Pakistan

The Pakistan Armed Forces are the military forces of Pakistan. The Pakistan Military consists of the Army, the Navy, and the Air Force, and is the sixth largest in the world in terms of active military troops. Several paramilitary groups, including the National Guard and the Civil Armed Forces, back up these three services. According to Global Firepower, the Pakistani armed forces are the seventh most powerful in the world. The Pakistan Army, a volunteer fighting force, forms the backbone of Pakistan's armed forces. There are around 550,000 regulars and 500,000 in reserve. Reports indicate that the Pakistani Army Aviation Corps has a fleet of around 250 aircraft, the majority of these being helicopters.¹⁰⁹ When it comes to surface-to-surface missiles, the Army Strategic Forces Command has a good amount of arsenal at its disposal.

¹⁰⁷ Ansari, Usman. "Pakistan Boosts Defense Budget by Nearly 6%." Defense News, June 11, 2022. <https://www.defensenews.com/global/asia-pacific/2022/06/10/pakistan-boosts-defense-budget-by-nearly-6/>.

¹⁰⁸ MoD India. "Defence Gets Rs 5.94 Lakh Crore in Budget 2023-24, a Jump of 13% over Previous Year." Accessed February 2, 2023. pib.gov.in/Pressreleaseshare.aspx?PRID=1895472.

¹⁰⁹ India vs Pakistan: Military strength and arsenal | News | Al Jazeera. "India vs Pakistan: Military Strength and Arsenal," February 26, 2019. <https://www.aljazeera.com/news/2019/2/26/india-vs-pakistan-military-strength-and-arsenal>.

The Pakistan Air Force is the largest in the Muslim world and the seventh largest air force in the world, with more than 450 combat fighter jets and more than 350 trainers, transport, communication, helicopter, and force-multiplier aircraft.¹¹⁰ When it comes to Naval Force, the foundation of the Pakistan Navy in 1947 was made possible by Indian Muslim officers who were already serving in the Royal Indian Navy. It has around 71 commissioned vessels and 36,000 active-duty troops, and its operational scope has evolved to encompass increasing national and international responsibilities in the battle against sea-based global terrorism, drug smuggling, and trafficking challenges.¹¹¹

Apart from the Pakistan military, another agency called ISI (Inter-Services Intelligence) is also Pakistan's Intelligence and spy agency. On numerous occasions, it has been responsible for terrorism in India through various terrorist groups. Overall, Pakistan maintains a big military and poses a reasonable threat to India from its Western land borders and through the Arabian sea. The threat from Pakistan is both military and non-military terrorist groups.

4.2.2 China

The People's Liberation Army, known simply as the PLA, is the primary armed force of the People's Republic of China as well as the armed branch of the Chinese Communist Party (CCP). The People's Liberation Army (PLA) is composed of five different branches of service: the Ground Force, the Navy, the Air Force, the Rocket Force, and the Strategic Support Force. The Central Military Commission (CMC) is in charge of the military's management, and the

¹¹⁰ Pakistan Air Force (2023). "Pakistan Air Force (2023)." Accessed February 5, 2023. <https://www.wdmma.org/pakistan-air-force.php>.

¹¹¹ Shah, Sabir. "An Overview of Pakistan's Naval Prowess." An overview of Pakistan's naval prowess, February 5, 2023. <https://www.thenews.com.pk/print/790270-an-overview-of-pakistan-s-naval-prowess>.

head of that commission serves as the overall commander.¹¹² The vast majority of military forces located around the country are now delegated to one of the five theater commands based on their geographic location. If we exclude reserve and paramilitary troops, the People's Liberation Army of China (PLA) is the biggest military force in the world, and China's defense budget is the second highest in the world. It is also one of the armies that are modernizing at the quickest rates in the world, and it has been labeled a future military powerhouse since it has strong regional defensive capabilities and increasing power projection capabilities globally.

More than 2,035,000 people are serving actively in the military, far outnumbering the roughly 486,000 Americans in the military.¹¹³ China's military might has been substantially increased due to the addition of several new weapons, most notably to the Navy's arsenal. China already has two aircraft carriers, making it one of the few nations with this capability. As a result, the Navy is where the armed forces are expanding most. As such, it is clear that the Chinese military has lofty goals, including becoming an expeditionary force like the United States' and being capable of challenging NATO in any part of the globe. Also expanding, the air force now possesses more than 2,500 aircraft, including almost 2,000 combat aircraft, making it the biggest in the Asia-Pacific region and the third largest in the world. The air force presently has a number of stealth fighter planes, the most notable being the J-20, China's most modern warplane. It was built to rival the performance of the American-made F-22 but was created independently.¹¹⁴

¹¹² Encyclopedia Britannica. "Lin Biao | Chinese Military Leader." Accessed February 5, 2023. <https://www.britannica.com/biography/Lin-Biao>.

¹¹³ Yuan, Shawn. "Just How Strong Is the Chinese Military?" Just how strong is the Chinese military? | Military News | Al Jazeera, October 29, 2021. <https://www.aljazeera.com/news/2021/10/29/just-how-strong-is-the-chinese-military>.

¹¹⁴ Ibid.

China is one country that has created a different arm to look after the ballistic missiles it has in its inventory and calls it the PLARF (People's Liberation Army Rocket Force). The PLARF gives China strategic reach up to the US with the ability to strike from the home base with Inter Continental Ballistic Missiles (ICBM). Overall, China is a formidable and hostile neighbor to India. It has existing border disputes with India and has an all-weather ally Pakistan, which is again not a friendly nation to India. China poses threat to India from its northern and Northeastern borders.

4.2.3 Threat Assessment

India shares an approximately 3,500 km long land border with China and a 3,300 Km long land border with Pakistan. This totals nearly 6,800 Km of land border with unfriendly yet capable militaries. Apart from the land border, India has a long maritime boundary of approximately 7,500 Km part of which could be exposed to Pakistan from the side of the Arabian Sea.¹¹⁵ Both China and Pakistan possess capable forces that need to be tackled by India one at a time or simultaneously in rare situations. Both air forces have a large number of military aircraft and are also actively pursuing drone programs. The aerial warfare capabilities of China are similar to India though in Pakistan's case, India has an upper hand.

Apart from the stated facts above, India has faced both countries in conflict from minor skirmishes to total war scenarios. India has been to war with Pakistan in 1965 and 1971. Both these wars saw the use of Air Forces on both sides and high intensity of aerial warfare. With China, India went to war in 1962, however, this war did not see reasonable aerial warfare.

¹¹⁵ BYJUS. "List of Neighbouring Countries of India - Country Capital, Map & Facts," September 6, 2020. <https://byjus.com/govt-exams/neighbouring-countries-of-india/>.

Notwithstanding, China has built a large air force since then that is capable of fighting an aerial war with India. Both China and Pakistan pose a reasonable aerial threat to India and it is expected that any war in the future will also see a high-intensity aerial conflict. Thus, it is prudent for India to be prepared for any aerial conflict in the future and therefore, the need to strategise the use of drones for any future conflict. Drones are expected to be an inseparable part of any future aerial warfare capability.

4.3 Strategising Use of Drones by India for Modern Aerial Warfare

In the previous discussions, it has been seen that drones have emerged from the shadow of manned aircraft to become an important instrument of aerial warfare. Many countries including India's hostile neighbors have absorbed and adapted to this technology which could prove to be a game changer as has been seen in a case study too. Therefore, it is high time that the use of drones is well-strategised and documented to boost this capability in the Indian context. However, this needs to be done in a step-by-step process.

First, it needs to be realised that the air strategy is incomplete without the inclusion of drones as many roles are today being performed by them. This entails doctrinal absorption of these war machines. Secondly, based on doctrinal changes and the roles in which drones are likely to be used, the required capability of drones for India needs to be specified. It must also be specified in the same place as how these drones will be used in the stated role. Lastly, the indigenous design and development of these drones need to be boosted in the country and measures to do so must be specified.

4.3.1 Doctrinal Absorption of Drones

The Indian Air Force's basic doctrine recognizes various campaigns under the Air strategy. These include Counter Air Campaign, Counter Surface Force Campaign, Strategic Air Campaign, and Combat Enabling Operations. Counter Air Campaign involves air operations undertaken to achieve control of air through Offensive Counter Air Operations and deny control of air to the enemy through Air Defence Operations. Counter Surface Force Campaign includes Air Land operations against the enemy's ground forces and Maritime Operations against the enemy's naval forces. Strategic Air Campaign involves Conventional Strategic Air Operations and Nuclear Air Operations. Finally, Combating Enabling Operations includes Air Operations and Ground Operations. These operations are mainly focused on supporting the previous three campaigns and include multiple constituents. Drones or Remotely Piloted Aircraft as the IAF calls it, currently are constituent of Combat Enabling Air Operations. It means that they find a very small role in the IAF doctrine to date while they have the capability of being much more useful than that in Air Operations.¹¹⁶

The usefulness of drones needs to be illustrated under each campaign by assessing their utility in each campaign. To start with Counter Air Campaign, drones can find a place in Offensive Counter Air Operations as they are capable of executing offensive roles in the current scenario.¹¹⁷ They can be employed in SEAD (Suppression of Enemy Air Defence) operations as they have already seen utility in destroying a battery of S-300 Surface to Air Missile recently in the ongoing Russo-Ukraine war. They can also be used to attack various target systems on an airfield with air-to-surface weapons. Air Defence operations, however, may not have much use

¹¹⁶ Indian Air Force. 2012. *Doctrine of the Indian Air Force*. New Delhi, India: Directorate of Operations IEW, IAF.

¹¹⁷ Ibid.

for drones till they get air-to-air weapons and start hosting radars which must also be considered for future use.

Drones can also play a big role in Counter Surface Force Operations as many countries today operate armed drones capable of carrying air-to-surface weapons that can be used to address targets of enemy ground forces as well as maritime forces. They can be used in all roles of air-land operations that include Air Interdiction, Battlefield Air Interdiction, Battlefield Air Strike, Tactical Recce, and Search and Strike. The first three roles can be executed with armed drones while the Tactical Recce needs recce sensors to be installed on the drones. Search and Strike can be addressed by both armed drones with high loiter time and kamikaze drones. Maritime targets can be similarly addressed by armed drones with air to surface weapons, however, for anti-shipping operations, there will be a requirement to employ HALE (High Altitude Long Endurance) drones that can go long into the sea yet be safe from the defenses of the ship.

When it comes to Strategic air campaigns, drones can be used to target industrial infrastructure as displayed by Houthi rebels in 2019 by executing an attack on the Saudi ARAMCO petroleum company.¹¹⁸ The effect of the strike was very limited as it was performed by a non-state actor, however, it can be of much larger magnitude in case it is performed by a state actor. Drones have the capability of executing psychological operations too as seen during the Armenia-Azerbaijan war of 2020, wherein drones were used by Azerbaijan to attack the undefended troops of Armenian forces. The cameras installed on the drones took the videos of these attacks and that was real-time transferred to the GES (Ground Exploitation Systems) of

¹¹⁸ Reid, David. "Saudi Aramco Reveals Attack Damage at Oil Production Plants." CNBC, September 20, 2019. <https://www.cnbc.com/2019/09/20/oil-drone-attack-damage-revealed-at-saudi-aramco-facility.html>.

Azeri forces. These videos displaying severed and damaged dead bodies of Armenian soldiers were circulated on YouTube creating a psychological effect on Armenian forces. Thus, drones created a huge psychological impact on Armenian forces bringing out a strategic effect of those strikes. As far as nuclear strikes are concerned, though no known use of drones in nuclear warfare is known, however, there is an adequate possibility of arming drones with nuclear warheads, especially tactical nukes.

The last arm of Air Strategy is Combat Enabling Air Operations which includes air operations as well as ground operations. Remotely Piloted Vehicles or Drones form part of air operations under Combat Enabling Operations. The drones are capable of performing multiple operations within their group that includes Surveillance & Reconnaissance, and Electronic Warfare, and can also be a part of Search & Rescue operations as the locator sensors of downed pilots. Further, in underground operations of combat enabling operations, drones have already created a space for themselves in Ground Defence and Special Force Operations as they can act as sensors that can keep surveillance on the approach points of VA (Vital Areas) & Vital Points (VPs) and can assist Special Forces in the conduct of their operations by becoming sensor feeders.

Apart from the air strategy discussed above, the Indian Air Force also considers its usage in sub-conventional operations against non-state actors. During the infamous attack on Entebbe, which was carried out by the Israelis, they were among the first to effectively deploy air power in combination with Special Forces in order to carry out an operation against terrorists. Since that time, air power has been used offensively by Turkey against Kurdish insurgents, by Russia against the rebels in Afghanistan and Chechnya, by the United States and coalition forces in Kosovo, Afghanistan, and Iraq, by Sri Lanka against the LTTE, and most recently by Pakistan

against the Taliban in the Swat region of Pakistan.¹¹⁹ In the latest application of air power against non-state actors, drones have proved to be utterly successful in eliminating leadership and other strategic targets using the concept of targeted killing. The US has used its Predator and Reaper drones in various countries like Pakistan, Somalia, Yemen, Iraq, etc. for the elimination of terrorists and insurgents. Thus, drones must form an inseparable part of sub-conventional operations and are required to be absorbed doctrinally.

4.3.2 Defining Drone Technology Requirements

Capability enhancement in drone technology is based on what type of drones will be required by the Indian Air Force and how will they be used. Based on the assessment of doctrine for various roles in which drones can play an important part, it is required to zero down to the types of drones that will be needed by IAF and their application in combat. Building a drone infrastructure is not easy but it needs well-calculated present application and adequately predicted future usage otherwise by the time the technology is well adapted, it has the potential to go obsolete.

When it comes to Counter Air Campaigns, India needs drones that can penetrate the defences of Surface to Air Missiles (SAM) and attack their components for the execution of SEAD/ DEAD missions. When targeting radars that are not defended, drones do not need to save themselves from incoming missiles from a missile system. Even in the case of SAM systems, if the altitude coverage of missiles is only up to medium levels, HALE (High Altitude Long Endurance) drones can destruct the missile systems. Highly lethal SAM systems can be targeted with the help of stealth drones that can reach much closer to missile system sensors

¹¹⁹ Indian Air Force. *Doctrine of the Indian Air Force*.

without getting detected. SAMs located close to border areas can be addressed with kamikaze drones, loitering munitions, or even swarm drones. Early warning and Surveillance radars can be addressed by MALE (Medium Altitude Long Endurance) drones that can fly at medium altitude, penetrate deep into enemy territory, and attack undefended targets. In all cases, to address deep-situated targets, satellite links with drones will be necessary. For attacking enemy airfields, stealthy drones will be necessary as it is expected that the enemy would defend its airfields with the help of SAM systems.

Counter Surface Force Campaign includes the use of aerial weapon systems that can attack enemy ground forces and naval installations. Armed drones with air-to-ground bombs and missiles are best usable against such targets. Loitering munition and swarm drones can be of use against the organic air defense assets of the enemy forces. While armed drones with short ranges are adequate for the conduct of operations Battlefield Air Strike and Battlefield Air Interdiction in the Tactical Battlefield Area, MALE and HALE drones would be necessary to undertake Air Interdiction and Search and Strike roles. Tactical recce can be undertaken by small drones with short loitering duration easily as they need to support the imminent operations by friendly forces. Maritime operations involving Antishipping and Maritime Strike operations surely require HALE drones that can go long distances and can save themselves from enemy fire from ships and coast.

The Strategic Air Campaign is best done with drones that can carry large weapon loads and have a long reach. For Strategic Bombing large weapon loads and long reach are required, however, to an extent it can be replaced with large drone swarms giving the same effect. Thus, drone swarming can come to the rescue of Strategic Bombing. Psychological warfare effects can be achieved by drones that can target and record the killing of soldiers from the above which can be aired on social media. These drones could be armed drones with short-range though

carrying sensors to relay the recordings of the damage done by the attacks. When it comes to nuclear attacks, drones have not been seen to execute such missions, however, it is expected that they will be able to carry tactical nukes in the future and thus may end up surprising the enemy with a nuclear attack when it is least expected from drones.

Drones for now are usually involved in Combat Enabling Operations in most air forces. Drones are currently executing Surveillance & Reconnaissance, Search, and Rescue operations and are being constantly used by Special Forces operations alongside base defence. However, their usage is constantly increasing with advancements in drone technology wherein their endurance is increasing, sensors are improving and miniaturization is taking place. Combat Enabling operations are the starting point for drones in IAF and much wider usage of these machines is being seen for the near future in this arena.

For Sub-Conventional warfare, drones are being used for a very long time by countries like the US and Israel. This warfare needs information about the movement and location of non-state actors and their leadership and then seeks to eliminate them, especially with the least damage to own forces and minimum collateral damage. For Surveillance and Reconnaissance, MALE drones are suited with high-quality onboard sensors to search, identify and track terrorists and insurgents. For targeted killings, drones like the Predator, Reaper, Bayraktar TB-2, etc. fulfil the requirements of tracking and shooting down the adversary. These drones normally would not require to penetrate deep inside the enemy border and hence do not need satellite links and rather should be easily deployable and recoverable. Even hand-launched drones can be used for the tactical recce of infested areas.

From the above paragraphs, it is clear that there are multiple campaigns and operations to be performed by the air power of any country, and thus, when introducing drones in these operations, they must be customized to the type of operation they are undertaking. For example,

if a tactical recce drone of small size must be used in sub-conventional warfare, it must not see the use of a HALE drone that will be of limited use and an overkill. Thus, achieving correct cost-effectiveness will be the cornerstone in drone operations for any air force, ensuring numbers and low operating costs.

4.3.3 Capability Development for Drone Warfare in India

Drones are here to stay and will play a major role in the conduct of modern aerial warfare. No country can become a specialist in drone warfare without having the capability to design and develop the systems on its own. India being in a geostrategic location with adversaries to the West and North, has to consider the military lessons learned regarding drone warfare and apply the same to create a booming drone manufacturing sector. Indigenous capability development in modern drones is the hour's requirement. To this effect, there are certain aspects needed to be delved into to create a self-sustainable capability development in drones and drone technology.

4.3.3.1 Indigenous Component in Drone Development

Actual indigenous manufacturing will not be achieved until an independent faceless organisation does not assess the Indigenous Component (IC) with high integrity regarding any company claiming to Make in India. Indigenous components below 80% should be categorized as assembled in India instead of made in India. Such drones use 100% parts from China and merely assemble them here. This is clearly against the norms of national security. Preference in all govt tenders must be given to those with higher indigenous components.

4.3.3.2 Research and Development

DRDO (Defence Research and Development Organisation), Defence PSUs, and other Indian R&D organisations assume a fundamental part in the indigenisation of advanced avionics. The improvement of cutting-edge flying machine advancements, including drones, is an obscure region, wandering into which requires an undeniable degree of examination, subsidizing, and government support. These elements, after getting corporatized, should be held accountable, and the emphasis should be on achieving targets within the predefined period.

4.3.3.3 Supply Chain Based on Imports

India's private new businesses like Garuda Robotics, Idea Forge, Airpix, and Edall Systems have a basic reach in drone innovation. They are subject to unfamiliar providers for semiconductors, lithium polymer batteries, impact aversion frameworks, motors, etc. Some Indian businesses have created empowering advances for drone tasks, notwithstanding different difficulties. The essential task to zero in on is working with a native production network. That will be the development of real indigenous production of drones.¹²⁰

4.3.3.4 Business Models

PSUs in India's aviation industry have been criticized by industry watchers who claim their goods are improperly priced from a commercial and economic perspective. It has been an area of weakness for government R&D organisations to develop a reliable technique of pricing homegrown designs in preparation for licensing them to the commercial sector. For the design

¹²⁰ Narang, Rajiv Kumar. 2017. "Indigenisation of UAVs by India and Its Challenges." *Journal of Air Power and Space Studies*.

and production companies to make money, sustainable and profitable business models need to be figured out.

4.3.3.5 Economy of Scale

The business sector is less likely to invest in acquiring indigenously produced technology when there is ambiguity about whether or not consumers would place orders for items that were designed in-house. The economic sustainability of design and development projects suffers because the quantities ordered by the Indian Armed Forces and Central Armed

Police Forces (CAPFs) are often limited and based on their particular needs.¹²¹ Companies in the private sector are often hesitant to adopt locally developed designs due to their lack of long-term commercial viability. Since there is less of a financial incentive for designers to keep updating such systems due to the low volume of user orders, they quickly go out of date. If India's aviation sector, and notably its PSUs, are to compete on a global scale, these issues will need to be resolved.

4.3.3.6 Challenges for MSMEs and Start-Ups

Integration into the aviation sector is difficult for SMEs and new businesses. 45 percent of India's industrial production and 40 percent of the country's exports come from micro, small, and medium-sized enterprises. They have the potential to contribute significantly to the expansion of the aerospace industry, which includes the advancement of drone technology. The startups use novel ideas and the best of academia and industry to create ground-breaking

¹²¹ Ibid.

products for specific markets.¹²² However, they are limited because to issues with finances and a non-supportive atmosphere. There is no set time limit for approval, and they are not often given clear and full information on where they may contribute, the procedures for registering with aircraft manufacturing companies, and so on.

4.3.3.7 Financial Constraints

Innovative and one-of-a-kind designs and technology solutions are often developed by startups and MSMEs to fulfill the needs of the armed forces and provide them with a technological advantage. However, in order to be qualified to offer goods to military PSUs, they must promise a certain amount of capital that they may not have. Even after securing lucrative contracts, they often struggle to get the necessary operating capital. Small and medium-sized enterprises (SMEs) and startups need a number of permits and certifications before they can sell their wares to the military and other government agencies. These include a Defence Industrial Licence, an Explosives Handling Licence, a drone Licence, an ISO Certification, and so on. This creates an exceptionally tough and demanding economic environment for MSMEs and new ventures.¹²³

4.3.3.8 R&D, IPR, and Royalty

Companies in the private sector work with government research and development organisations like the Defense Research and Development Organisation (DRDO), the National

¹²² Chamber of Indian Micro Small & Medium Enterprises (CIMSME). “Chamber of Indian Micro Small & Medium Enterprises (CIMSME).” Accessed February 5, 2023. https://www.indiansmechamber.com/challenges_to_msme.php.

¹²³ Ibid.

Aeronautics Limited (NAL), and others to create cutting-edge indigenous components, systems, and sub-systems. On the other hand, R&D organisations hand over their concepts to PSUs to manufacture.¹²⁴ Developers and private sector businesses worry that their systems and sub-assemblies' Intellectual Property Rights (IPRs) aren't being properly safeguarded because they don't have guaranteed orders for mass manufacturing. Despite having indigenised such items or sub-assemblies for the R&D agencies, they must compete with others during the bidding process launched by the production agencies, i.e., PSUs. As a result of regulatory constraints, they are occasionally persuaded to transfer their rights to the PSUs.¹²⁵

4.3.3.9 Certification and Acceptance of Innovative IDDM Products

If the Indian armed forces do not increase their demand for new and distinctive aerospace goods and designs developed in India, then no Indian company or person will be able to get a certification for such items. This is because there is currently no authorized agent available with the necessary technical skills to examine IDDM (Indigenously Designed, Developed and Manufactured) and novel goods, determine their level of indigenisation, and certify them. Therefore, they have little choice but to sell their cutting-edge innovations to the aviation industry's behemoths throughout the world. For instance, Louis George and Kuruvilla George of Cochin, India, launched Verdant Telemetry and Antenna Systems Pvt Ltd in 1997 to provide airborne and shipping antennas to major aerospace and military companies of the world. Israel has incorporated its antennas into its newly acquired Searcher and Heron drones, as well as the US has used them on C-130 transport planes that are sold to India. Yet, at first, the company had

¹²⁴ Ibid.

¹²⁵ Narang, Rajiv Kumar. "Indigenisation of UAVs by India and Its Challenges."

a hard time selling its wares in India. Entrepreneurs in India worry that they would be unable to compete with established international firms in the country and indigenisation, thus taking a back seat.

4.3.3.10 Need to Review Defence Acquisition Plan

The current 15-year Long-Term Perspective Plan of the Indian armed forces does not give precise skills, technologies, and goods necessary in a limited time, and therefore the MSMEs and start-ups believe they cannot contribute properly to indigenisation. They have been insisting that the armed services create purchase plans for the next year and the next five years. Small and medium-sized enterprises (SMEs) and startups would benefit greatly from having access to annual and five-year purchase plans so that they may better prepare for the needs of the military. They'd be in a better position to make meaningful and useful contributions to indigenisation if they did this.¹²⁶

4.3.3.11 Role of the Armed Forces

Users are reluctant to purchase homegrown technology since it is seen as antiquated and inadequate for modern military and security needs. However, it is not feasible to create the greatest from scratch using just indigenous resources. The question at hand is how to pursue indigenisation while still satisfying the needs of the defence and intelligence establishments. The Indian military has extensive expertise with a variety of aerial platforms. In the top nations that produce and sell military aircraft, the armed services have been found to play a crucial role in the creation of both manned and unmanned aircraft. However, in India, the military forces

¹²⁶ Ibid.

are not engaged in the planning or design stages of aviation projects; rather, they are undertaken by R&D organisations like DRDO, NAL, and HAL. R&D firms miss out on crucial insights during the ideation and sketching phases as a consequence.

4.3.3.12 Academia in Indigenisation

India has the second-largest pool of scientists and engineers in the world, with over 380 universities, 11,200 colleges, and 1,500 research institutes, according to a study by the Planning Commission Working Group on the Aerospace Sector in 2012. The country of India is falling behind in the field of basic research because of its lack of support for its higher technical education institutions. India's economy has improved, but the country is still reliant on foreign producers for basic technology.

4.4 Conclusion

The theory of realism states that state survival is the utmost priority for realists, the ultimate aim is the survival of the state, which is why the acts of states are assessed according to the ethics of responsibility rather than by moral standards. Realists see the preservation of the state as the most important aspect of its existence. India is blessed with a neighbourhood that ensures that the nation is always working to improve its military capability to ensure state survival in dire straits that have existed in the past and have great potential to exist in the future. Maintaining a relevant military and being prepared for the next war is thus a priority action that India must take to ensure its survival. Drones will form part of all military actions in the future with constant improvements and India cannot remain behind in this technology. Thus, Indian Air Force must adopt drones into its doctrine and India must work towards the design and development of these future technologies. The government must also create an environment for

the indigenisation of these war machines that will pave the way for India to become a drone superpower.

CHAPTER FIVE: CHALLENGES AND OPPORTUNITIES FOR INDIA IN DRONE

WARFARE OF THE 21ST CENTURY: FIELD STUDY

5.0 Introduction

This research carried out a survey with the intent to obtain data regarding challenges and opportunities that indicate a way forward for strategising the use of drones in modern aerial warfare for India. Inputs received were analysed and presented in subsequent paragraphs. The survey questions, placed in the appendix, were framed to examine the objectives of this study. The stated objectives of the study were to examine the global evolution of various types of drones in the shadow of manned aircraft, to evaluate the fast-growing employment of drones, and assess the roles and tasks that can be performed by drones in modern aerial warfare and finally to doctrinally analyse how drones can effectively be involved in various types of military campaigns keeping India at centre stage. The questions framed in the survey questionnaire required adequate knowledge about drone warfare and the current usage of drones, therefore, respondents were carefully chosen with adequate knowledge of modern aerial warfare and the employability of drones in military conflict.

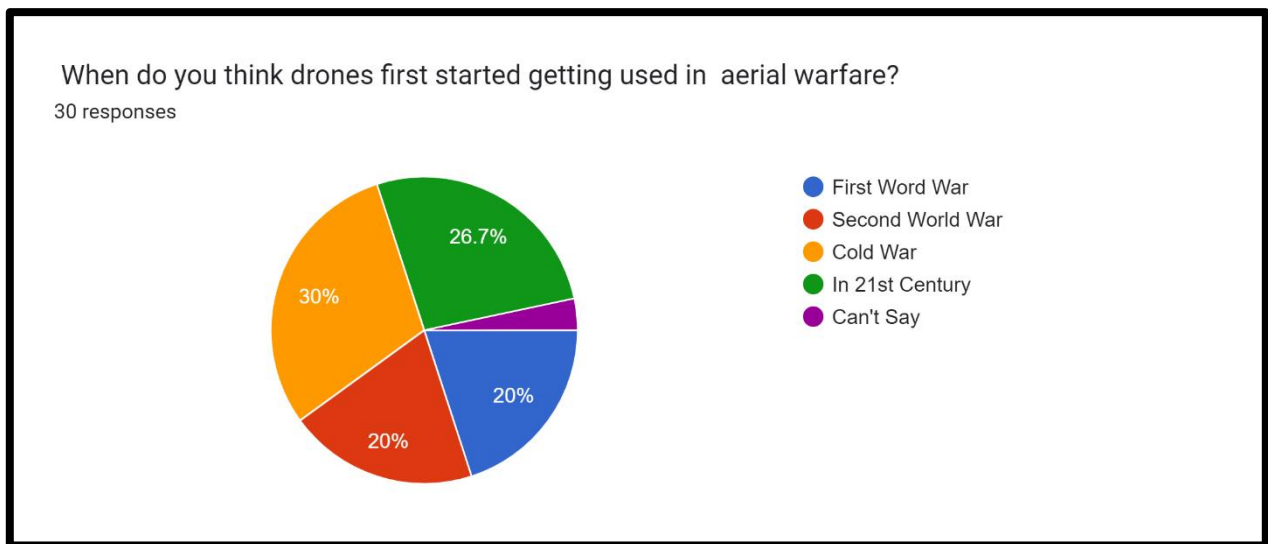
The study was intended to be concluded by strategising the use of drones in modern aerial warfare for India, therefore, a large percentage of the respondents chosen are of Indian armed forces' active members or veterans that have adequate knowledge about the subject. A total of 42 members were approached, of which 30 responded. The questionnaire was kept objective to ensure that respondents were motivated to fill and complete it.

5.1 Data Presentation and Analysis

The data from the survey was analysed and is presented in the subsequent sections and arranged based on the study objectives.

5.1.1 Evolution of Drones from the Shadow of Manned Aircraft

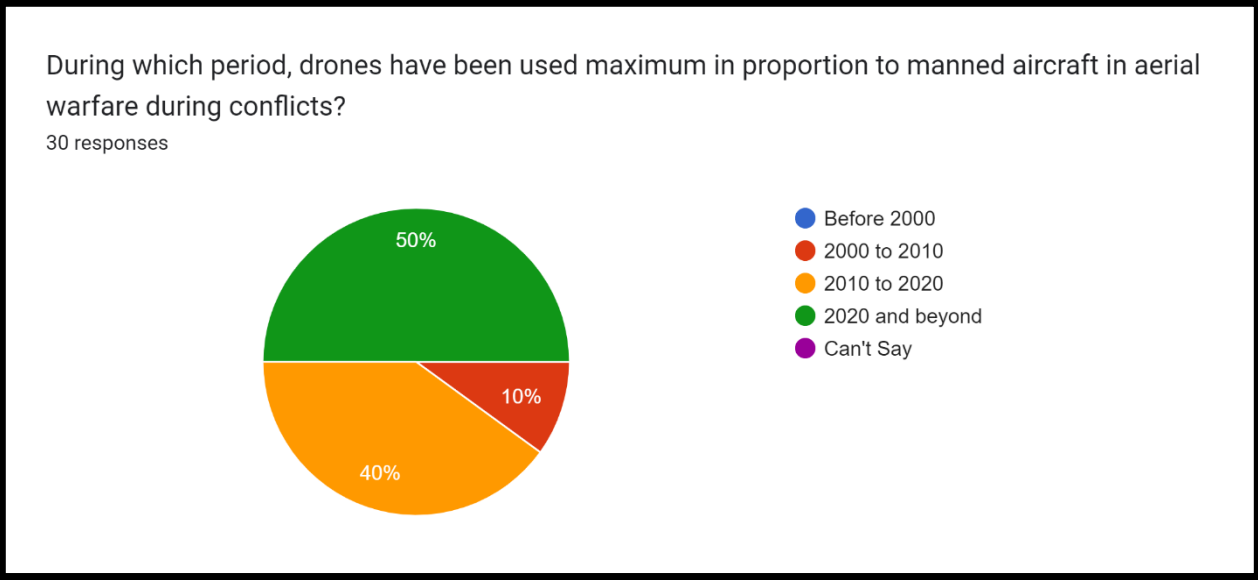
5.1.1.1 When do you think drones first started getting used in aerial warfare?



Source: Field Study: 2022

This question sought to assess the way drones have evolved from under the shadow of manned aircraft. This question got mixed responses from the respondents and thus indicates that their evolution has gone a bit unnoticed. Drones have also not been given adequate attention during the process of their evolution for the conduct of aerial warfare. Rather, much more attention has been taken away by the generational changes of manned aircraft that were and still are the spearhead of any aerial warfare. It is noteworthy that the respondents are in some or the other manner connected with aerial warfare.

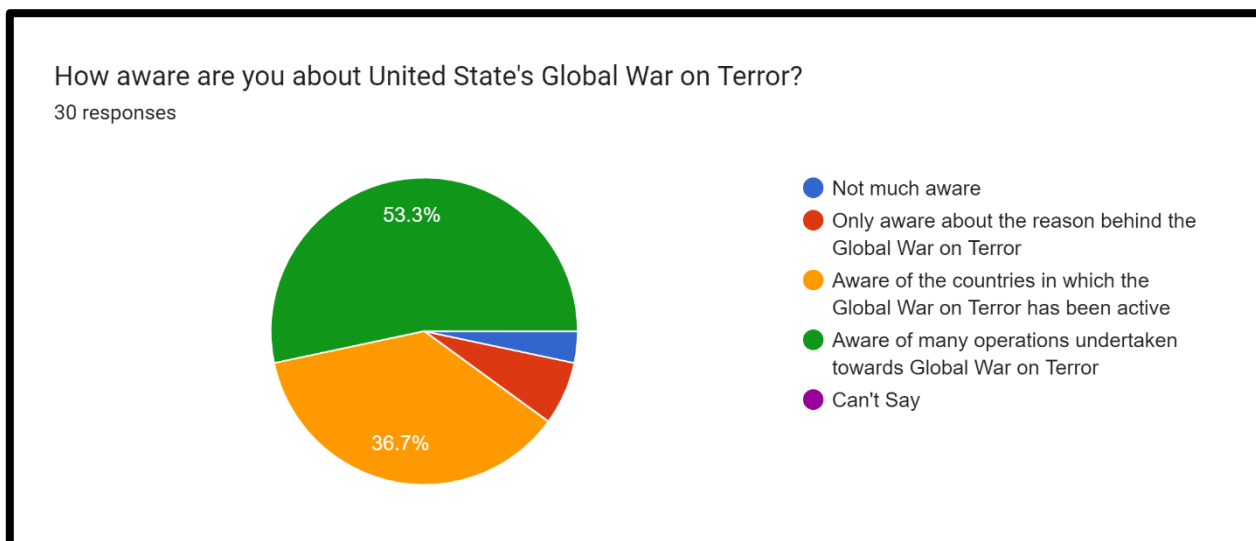
5.1.1.2 During which period, drones have been used maximum in proportion to manned aircraft in aerial warfare during conflicts?



Source: Field Study: 2022

The responses to this question indicate the usage of drones being maximum in 2020 and beyond is testimony to the fact that they have started appearing in aerial warfare very recently besides manned aircraft. The countries that have adequately invested in these technologies have started reaping the benefits by supplying these war machines to the nations involved in conflicts. This is also indicative that this technology has picked up pace now, though it will continue to improve in the future, hence if nations that intend to possess good military capability do not invest in these machines now then they will lag far behind others and may not be in a position to recover. The clear result will be losses in conflicts and missed opportunities to be a part of this technology.

5.1.1.3 How aware are you of United States' Global War on Terror?

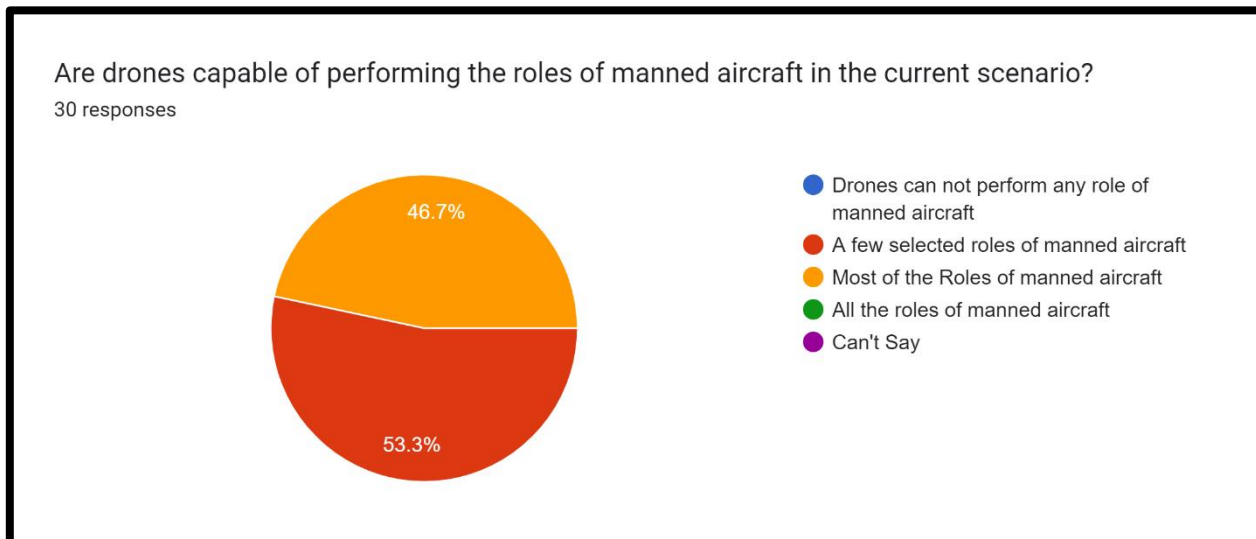


Source: Field Study: 2022

Most respondents were well aware of United States' Global War on Terror and its activities. Various countries like Yemen, Somalia, Syria, Pakistan, Afghanistan, etc. have been battlefields for targeted killings by US drones. The awareness of respondents is indicative of the fact that the world is closely monitoring advancements in the field of targeted strikes through drones and thus countries are likely to be interested in acquiring such technology to use it on the battlefield. These technologies are disruptive in nature for aerial warfare as they can attack the opponent's leadership with precision that may turn out to be a game changer. Thus, procurement and/ or development of such technology must be a priority for any nation.

5.1.2 Roles and Tasks Performed by Drones in Modern Aerial Warfare

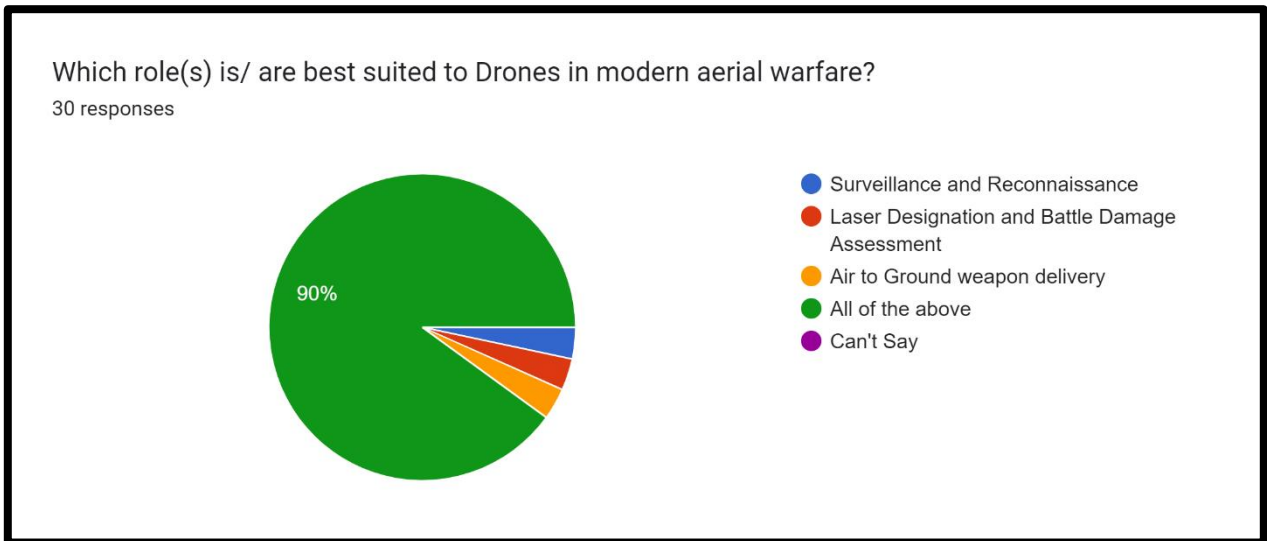
5.1.2.1 Are drones capable of performing the roles of manned aircraft in the current scenario?



Source: Field Study: 2022

The responses to this question were limited to only two options that are a few selected roles of manned aircraft and most of the roles of manned aircraft. Drones have been seen doing many roles of manned aircraft but they haven't taken over all roles. It is also noteworthy that the payload carriage capability of drones is usually much lesser than manned aircraft due to which restriction to take on all roles of manned aircraft seeps in. However, due to the reduced risk to human life during drone operations and the flexibility they offer, they complement manned aircraft well and are inseparable from the aerial warfare of contemporary times.

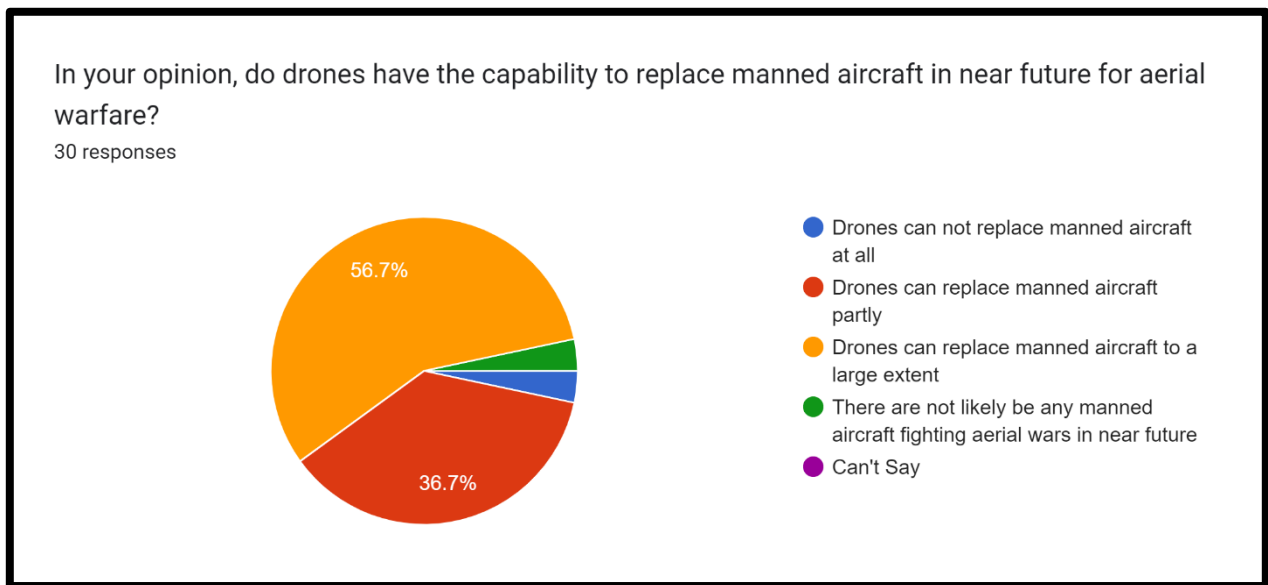
5.1.2.2 Which role(s) is/are best suited to drones in modern aerial warfare?



Source: Field Study: 2022

From above, 90% of the respondents said that all the roles of surveillance, reconnaissance, laser designation, battle damage assessment, and air-to-ground delivery are suited to drones. Destruction of enemy air defense and targeted killing come within the gamut of air-to-ground weapon delivery. Considering these options, it can be said that drones have extensive usage in aerial warfare as of date and it is assumed that the usage of drones will continue to increase as the technology evolves further. It is, therefore, absolutely necessary to strategise their use and invest in this technology focusing on future needs.

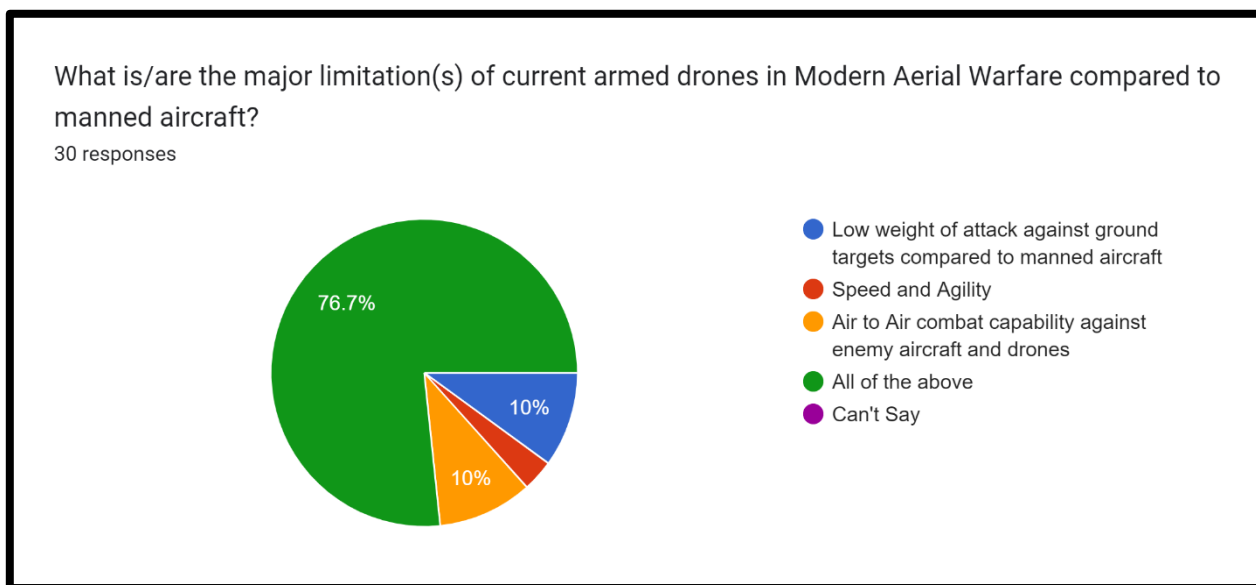
5.1.2.3 In your opinion, do drones have the capability to replace manned aircraft in near future for aerial warfare?



Source: Field Study: 2022

More than half of the respondents believe that drones can replace manned aircraft in near future for aerial warfare while a large chunk of nearly 37% of respondents feel that drones can partly replace manned aircraft. This is likely to be based upon the fact that drone technology is progressing forward at a very rapid pace and the way drones have already made their space in aerial warfare for many roles, this quest to take on more and more roles will continue to increase. In a nutshell, this is no looking-back technology that must be possessed by all aspiring nations.

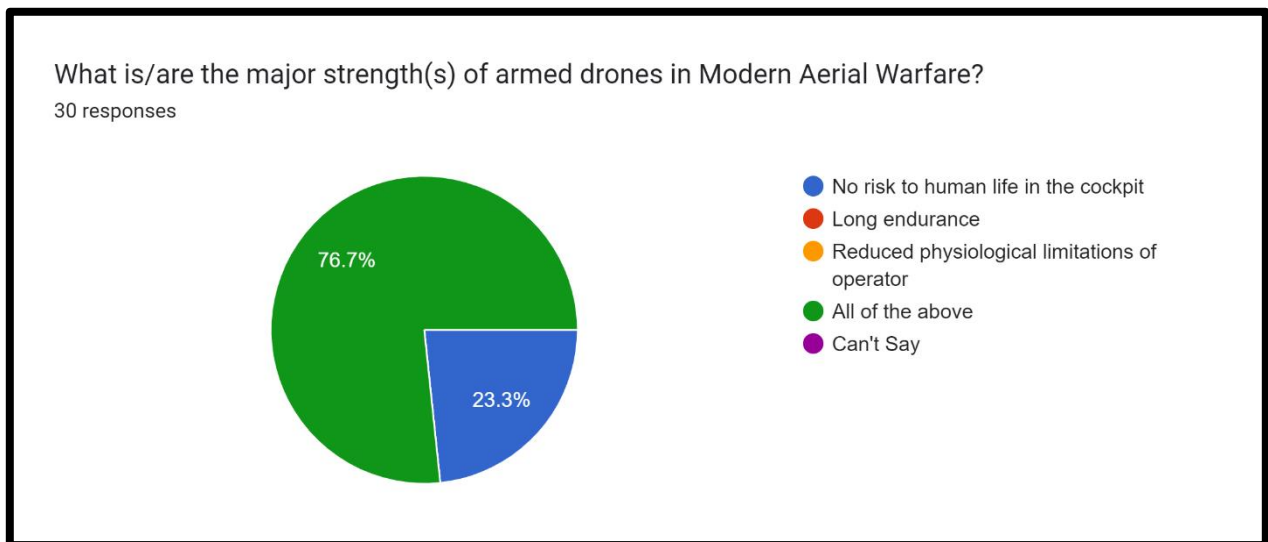
5.1.2.4 What is/ are the major limitation(s) of current armed drones in modern aerial warfare compared to manned aircraft?



Source: Field Study: 2022

More than 75% of respondents count some limitations like the low weight of attack against ground targets, speed and agility, and air-to-air combat capability against enemy aircraft & drones as decisive when drones are compared to manned aircraft. There is no doubt that when a pilot sits inside the aircraft, he considers the plane as an extension of his body and is able to control the aircraft conveniently as he sees outside and around the aircraft. This is something that lacks in a drone causing these limitations to come into play. For example, Global Hawk, though is one of the largest drones around but is still restricted to just 2000 pounds of payload carriage, which is quite less compared to average fighter planes that can carry more than five times this weight. The requirement thus would be to find a fix to these problems through advancements so that more and more capable drones can be brought onto the battlefield.

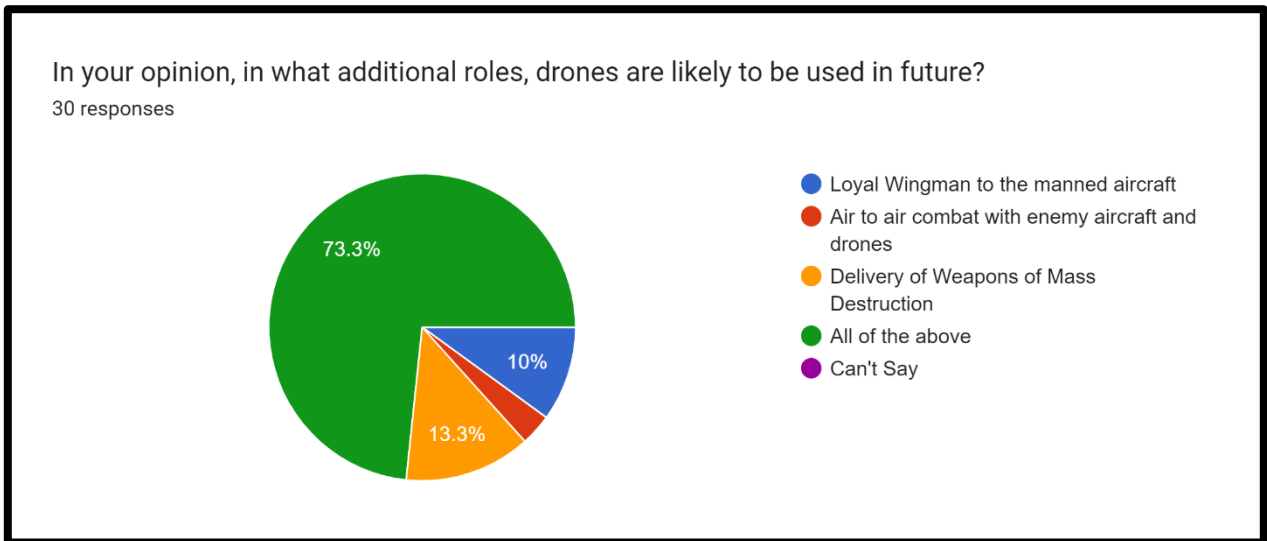
5.1.2.5 What is/ are the major limitation(s) of current armed drones in modern aerial warfare compared to manned aircraft?



Source: Field Study: 2022

More than 76% of respondents believe that the major strengths of drones include no risk to human life in the cockpit, long endurance, and reduced physiological limitations of the operator while 23% of respondents intend to concentrate on the strength of reduced risks to pilots. It is visible through the responses that multiple advantages are added when drones are sent to the battlefield and these advantages are not available in manned planes. These advantages have the capability to lure militaries to invest in this technology and place them alongside manned missions or replace them when it is possible.

5.1.2.6 In your opinion, in what additional roles, drones are likely to be used in the future?

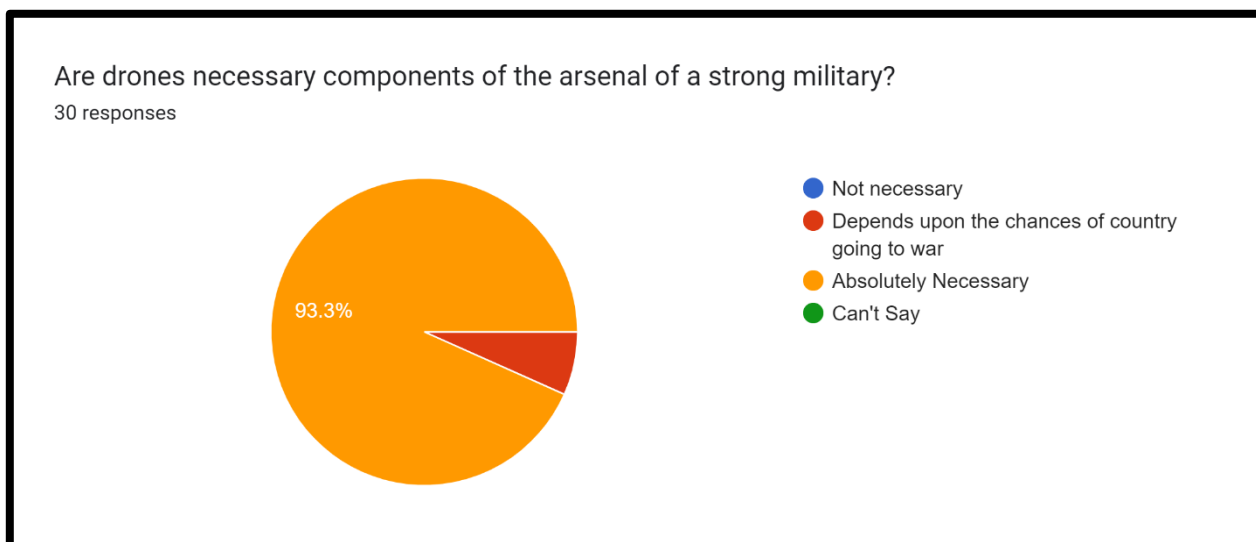


Source: Field Study: 2022

Nearly three-quarters of respondents believe that drones will be a loyal wingman to manned aircraft, will perform air-to-air combat with enemy planes, and will be used for the delivery of weapons of mass destruction in the future. Small percentages of leftover respondents were divided in their opinion on these three roles. Such belief stems from the continuously evolving process of drone technology and progress that has been shown in the last decade when drones started getting used on battlefields extensively. It means that more research and development must be undertaken by militaries lagging in this race must be undertaken to catch up with drone superpowers.

5.1.3 Strategising the Use of Drones for India

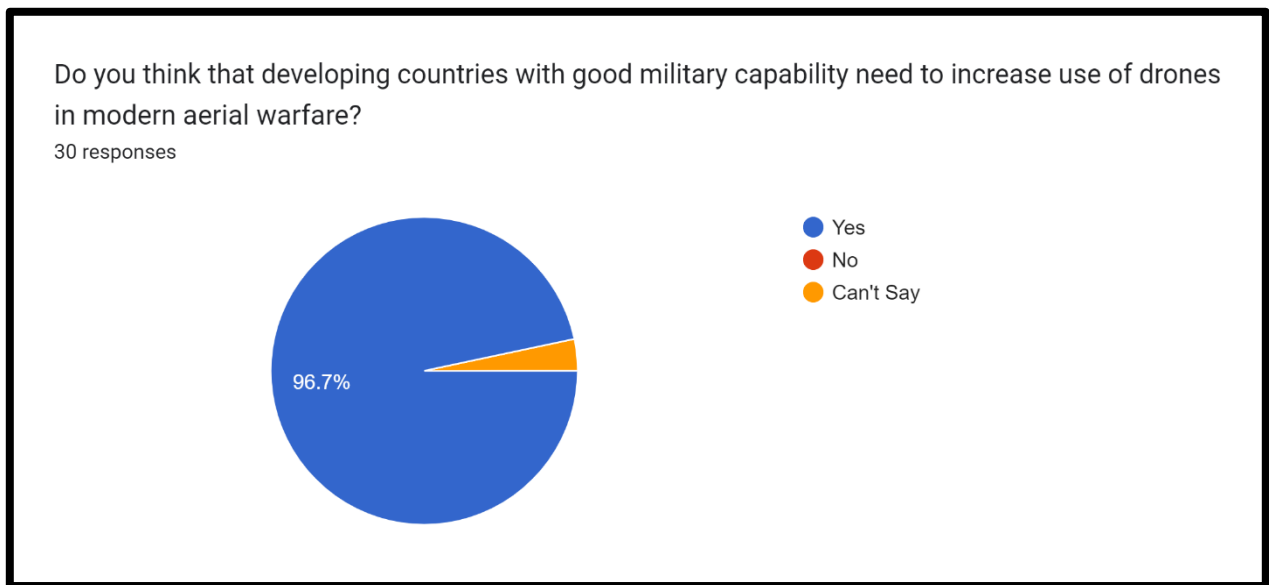
5.1.3.1 Are drones necessary components of the arsenal of a strong military?



Source: Field Study: 2022

More than 90% of respondents opinionated that drones are absolutely necessary components of the arsenal of a strong military. Their absence will ensure that the militaries will miss out on one important component that could be a game-changing technology in aerial warfare. Drones have been extensively used in the last few wars around the globe and it is nearly certain that as more and more roles are taken by these war machines, their density in war zones will continue to increase. Therefore, drones must be considered by various nations as a necessary component of the military arsenal.

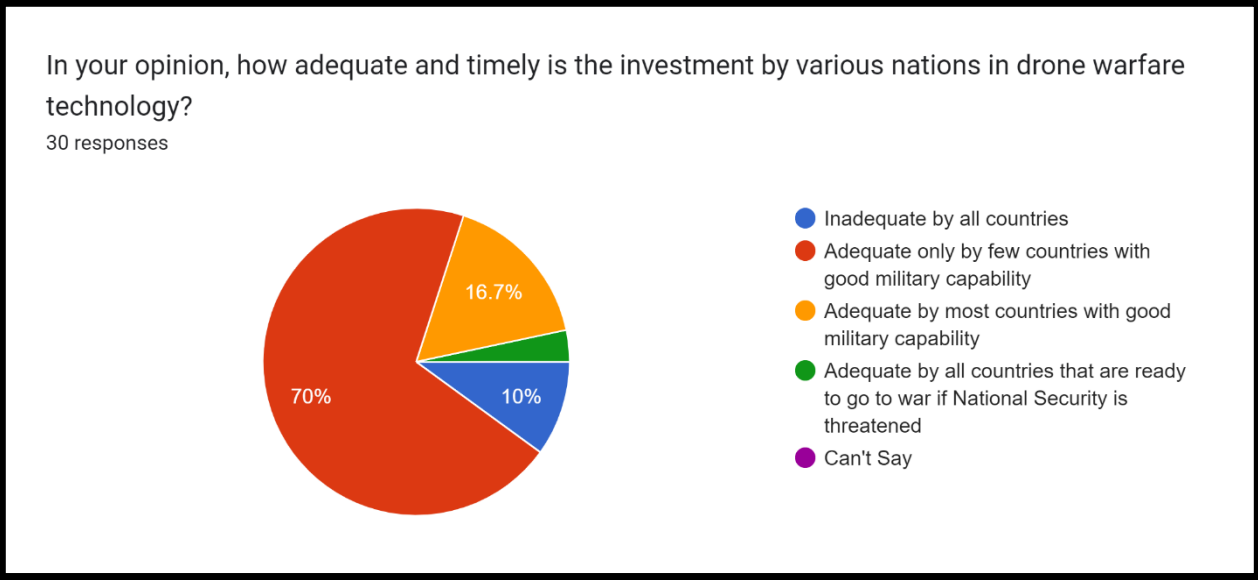
5.1.3.2 Do you think that developing nations with good military capability need to increase the use of drones in modern aerial warfare?



Source: Field Study: 2022

More than 95% of respondents opinionated that there is a need for developing nations with good military capability to increase the use of drones in modern aerial warfare. Developing nations like India still lag in the utilisation of this technology and are quite dependent on manned missions for most activities in aerial warfare. However, to make use of this technology and not lag far behind other nations, especially hostile neighbors, the usage needs to be increased. As the usage will increase so will the supply and the advancements in technology.

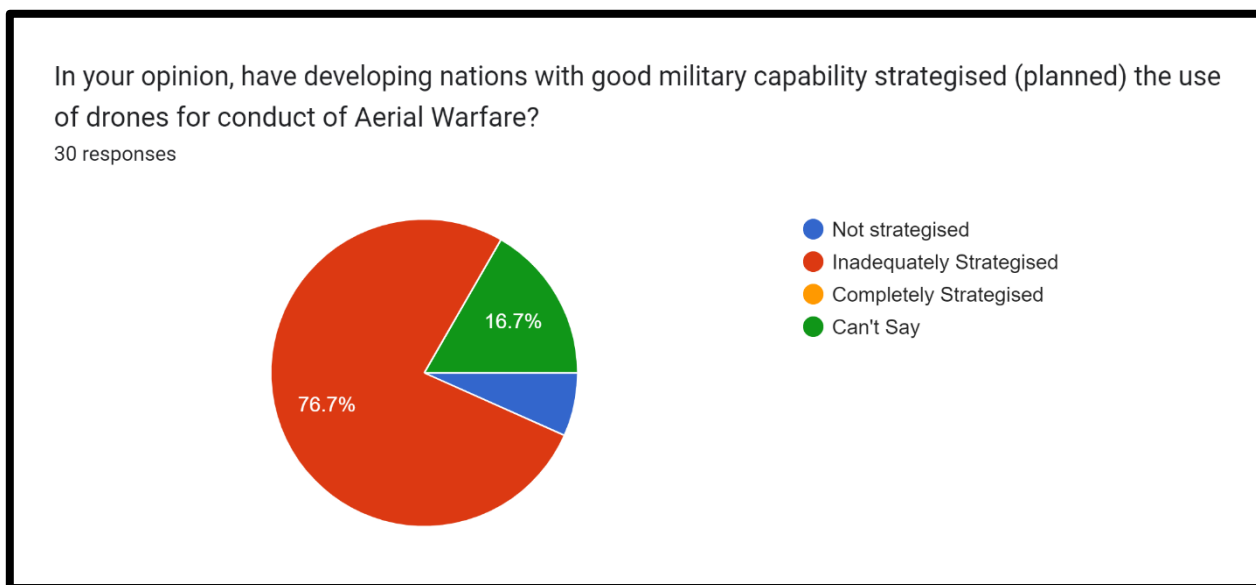
5.1.3.3 In your opinion, how adequate and timely is the investment by various nations in drone warfare technology?



Source: Field Study: 2022

From above, 70% of the respondents opinionated that the investment in the field of drone warfare is adequate only by a few countries with good military capability while 16% voted in favor of investment being adequate and timely by most countries. 10% of respondents also expressed that the investment in this field is inadequate by all countries. The research in previous chapters has brought to the fore that the investments in research and development in drone warfare have been done by only a handful of countries and there are some like Turkey, that have gone out of the way to acquire this technology. Notwithstanding, there is a lot of scope for developing nations like India that need to up the scale of investments in this field to become comparable with other drone superpowers.

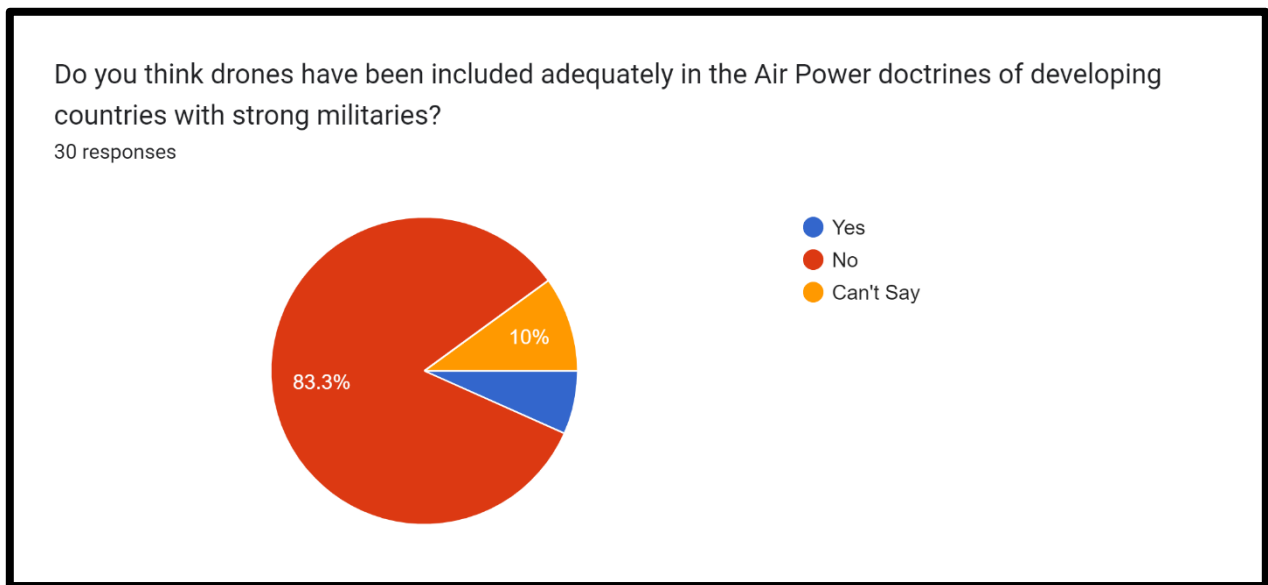
5.1.3.4 In your opinion, have developing nations with good military capability strategised the use of drones for the conduct of aerial warfare?



Source: Field Study: 2022

More than 90% of the respondents answered this question as either not strategised or inadequately strategised. Drones saw development first in Israel and then this technology was acquired by the US especially for waging its Global War on Terror. Most other countries concentrated only on manned aircraft. In the recent past, countries like Turkey, China, and even Iran have displayed some reasonable capability in this field. Many other nations and especially developing nations like India with good military capabilities are yet to display their involvement in drone warfare. The investments, design, and development will follow after nations have decided how they intend to use these machines in modern aerial warfare.

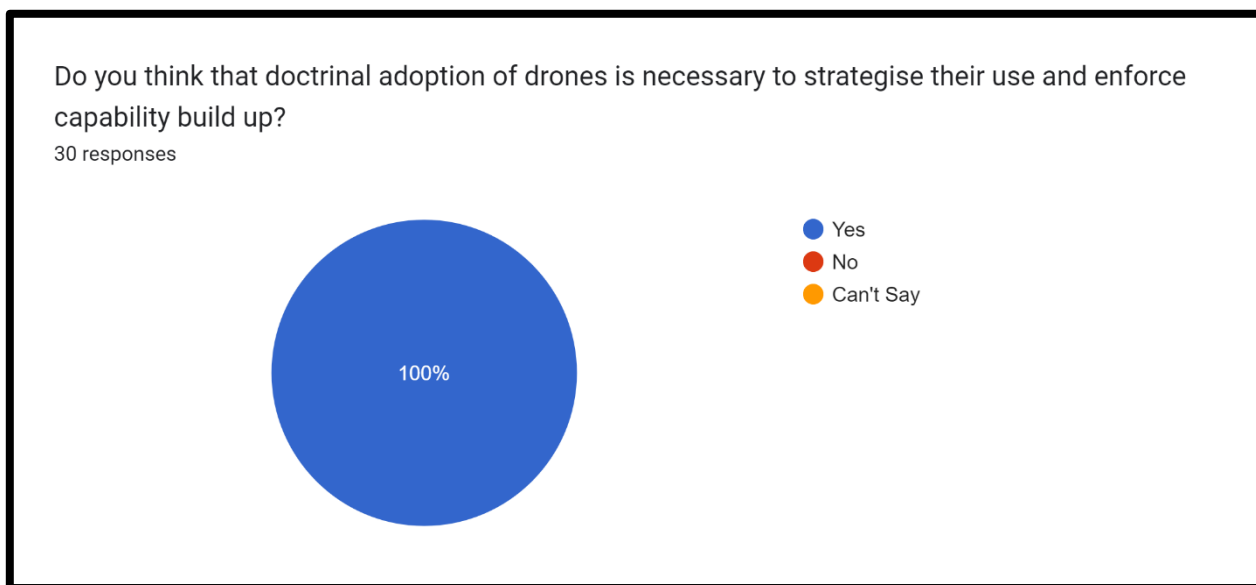
5.1.3.5 Do you think drones have been included adequately in the Air Power doctrines of developing nations with strong militaries?



Source: Field Study: 2022

More than 83% of the respondents feel that drones have not been included in the air power doctrines of developing nations with strong militaries. Most countries have concentrated on manned aircraft to use them as airborne platforms for the conduct of aerial warfare so far. Their long-term plans are still running to acquire more and more manned platforms as the budgets are limited and thus drones haven't found adequate space for budgeting in these nations. This is also one reason that has kept them from concentrating on drones and including them in their air power doctrines.

5.1.3.6 Do you think that doctrinal adoption of drones is necessary to strategise their use and enforce capability buildup?



Source: Field Study: 2022

From above, 100% of the respondents feel that doctrinal adoption of drones is necessary to strategise their use and enforce capability build-up. As the use of drones increases in aerial warfare of modern times, so will the concentration of nations on drones, and that shall result in them appearing in air power doctrines. However, this will be a reactive step and not a proactive approach. The nation that will take the proactive approach will benefit from this technology in both ways i.e., in using it for itself as well as producing it for exports earning economic benefits. Countries like Turkey invested heavily in this technology a decade back due to which today it is not only capable of using drones in different roles in modern aerial warfare but is also exporting them to countries like Azerbaijan and Pakistan.

5.2 Conclusion

The views received from the respondents on a range of matters that inform the objectives of this study were presented in this chapter. The inputs received were interrogated and analysed to draw value. The inputs were also correlated with the existing situation and future requirements to draw lessons for India to strategise the use of drones in modern aerial warfare. The aim of the exercise of data collection and analysis was completely achieved and the results have been included in the research work.

To summarise the field study, it can be assessed that drones are evolving fast and have seen maximum use in the 21st century. Their visibility in wars across the globe has increased considerably. They are being used in many roles that were earlier taken on only by manned aircraft and they display good strengths in the conduct of many missions when compared to manned missions albeit with some limitations to conducting high-speed, high-versatility missions. Nonetheless, as they are evolving rapidly, they will continue to overcome the limitations they have as of the date and will turn out to be game changers in future wars wherein the unmanned component in aerial warfare will continue to increase. They will be seen more and more in the roles of loyal wingmen, will start looking into air-to-air combat with enemy aircraft & drones, and will also be utilised in the delivery of weapons of mass destruction when necessary.

The above-stated progress in the field of drone warfare will make drones an absolutely necessary component of the military arsenal of any nation. Developing nations with strong military capabilities like India, thus need to enhance their concentration on the use of these machines in modern aerial warfare. India is lagging in this race as the use of drones has not been adequately strategised for modern aerial warfare and at the same time, adequate investments have not been made toward the research and development of this niche technology. One of the

reasons for lagging in this technology is also that drones have not been given adequately strategised by India and they lack the required inclusion in the air power doctrine. The inclusion of drones in airpower doctrine is an important step to strategise their use as that will open up multiple doors for the usage of drones in modern aerial warfare and will also enforce investments in this technology. Finally, this is the technology of the present as well as the future that is here to stay.

The theory of realism can explain state behaviour and the need to strategise the use of drones in modern aerial warfare. Realism emphasises the role of power, self-interest, and survival in shaping state behaviour and states are primarily concerned with protecting their national interests and ensuring their survival in a competitive global environment. When it comes to drone warfare, realist theory supports the idea of strategizing this type of warfare for a country for several reasons.

Firstly, realists argue that states should prioritize their security above all else. Drones can be used to target and eliminate threats to a country's security, such as terrorist organizations or enemy combatants, without putting the lives of soldiers at risk. This can be seen as a strategic advantage, as it allows a country to neutralize potential threats without incurring the costs and risks associated with conventional warfare.

Secondly, realists argue that states should maintain a balance of power in the international system. By using drones to target and weaken their enemies, countries can maintain their position of strength relative to other states in the international arena. This can be seen as a form of deterrence, as other states will be less likely to challenge a country that has the ability to strike from a distance and with precision.

Lastly, realists argue that states should pursue their national interests even if it means using force. In the case of drone warfare, countries may use drones to advance their economic,

political, or strategic interests, such as securing access to resources or protecting their allies. Realists would argue that this is justified as long as it aligns with a country's national interest and contributes to its overall security and survival. Overall, realist theory supports the strategising of drone warfare for a country as it allows them to prioritize their security, maintain a balance of power, and pursue their national interests through the use of force.

CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

The study was initiated with the aim to strategise the use of drones in modern aerial warfare for the Indian Subcontinent. The study was anchored on the theory of realism factoring in the need to seamlessly adopt this technology and make ways for its future development and indigenisation. It has been seen that drone technology is revolutionising the way military operations are conducted, offering new possibilities for surveillance, reconnaissance, and precision strikes. Therefore, states must take this technology seriously which will surely give an upper hand in military warfare if the need arises and thus it is absolutely necessary for state survival and accrual of power. As the use of drones continues to evolve, it is important to take stock of the findings related to this technology, including its benefits, risks, and challenges. This chapter seeks to provide an overview of the key findings related to drone warfare, as well as recommendations for policymakers, military leaders, and civil society organisations.

6.1 Summary of Findings

Drones have proven to be an effective tool in modern military operations, offering advantages in terms of surveillance, reconnaissance, and precision strikes. Their evolution started not long after the first manned aircraft flew but they started gaining prominence late into the 20th century when Israel took the lead in developing and using this technology. The United States followed suit partnering with Israel and these two countries became pioneers of drone technology that was first intended to be used for warfare. Their early entry into this field gave them a due advantage and they have reaped several benefits in aerial warfare. While Israel got

an upper hand in the Arab-Israel wars, the United States used these lethal machines in waging Global War against Terror, with both nations fetching favorable results. Dozens of countries like Turkey, China, Iran, etc. followed the pioneers of drone warfare and are currently enjoying indigenous drones for various roles, however, many developing nations with strong military capability like India, lagged in the process.

In the current scenario, drones are successfully performing multiple roles in aerial warfare that include Intelligence, Surveillance and Reconnaissance, Battle Damage Assessment, Targeted Killings, Destruction of Enemy Air Defence, and Air to Surface Strikes. Drones have proven their mettle in the Armenia-Azerbaijan war of 2020 wherein they tilted the balance in favor of the Azeri side bringing them a decisive victory over Armenia. They have also proven their worth in the Russo-Ukraine war while being utilised in multiple roles annotated above. The future is very bright for these machines as they are likely to be seen in many other roles like Unmanned Combat Aerial Vehicles, Loyal Wingman, Swarm Drones, delivery of Weapons of Mass Destruction, among others.

As of date, a few roles of manned aircraft can be performed by drones, however, as new roles are added, drones will start undertaking most of the roles of manned aircraft. However, they will continue to perform with limitations of speed agility and payload carriage although they win from manned aircraft in endurance, reduced risk to human lives in the cockpit, and reduced physiological limitations of the operator. In all, they will be one important component of the military arsenal of any country that intends to hold a strong and ambitious military strength.

As drone technology continues to evolve, it will be essential for policymakers, military leaders, and civil society organisations to work together to develop a comprehensive approach to drone warfare that maximises the benefits of this technology while minimising the potential

risks and drawbacks. There are a few nations like the United States, Israel, and Turkey that have laid adequate emphasis on these machines and are reaping the benefits now. However, many other developing nations like India that intend to hold a strong military need to lay adequate emphasis on strategising the use of drones in modern aerial warfare.

Strategising the use of drones in modern military warfare is not just knowing how to use the drones for the conduct of aerial warfare albeit it's a complete process of understanding drones, including them in doctrine, knowing how to use them, and finally bringing the idea on the table that would ensure they become a part of the military arsenal. Thus, even design, development, investment, and procurement also form part of the process. It needs to be ensured that the vision and doctrine bring together the intended use of drone technology for aerial warfare. Developing nations with strong militaries like India need to include drones in their air power doctrine and define roles for them that will lay a foundation to give these machines adequate importance for inclusion in aerial warfare and pave the way for increasing their presence. This will also be instrumental in enforcing the thought process around design, development, procurement, indigenisation, etc. so that a nation like India is not needed to be dependent on foreign vendors to fulfill its needs rather it may find avenues to become an exporter of this technology. Finally, the aim is to bring this latest and very effective technology to use in aerial warfare by Indian forces in an effective manner with adequate maintenance support.

6.2 Conclusion

Drone warfare has become an increasingly important component of modern military operations, offering a range of advantages over traditional military assets. From their ability to conduct surveillance and reconnaissance to their capacity to launch precise strikes against

enemy targets, drones have proven to be a valuable asset in combat operations. As India seeks to build its own drone warfare capabilities, it will be essential to stay at the forefront of these technological developments and consider a range of other factors, including doctrinal adoption, operational tactics, techniques, and indigenous design and development.

Drones present a big opportunity for not only safeguarding the borders but also for creating opportunities in the future. As drones continue to play an increasingly important role in military operations around the world, it will be essential for policymakers, military leaders, and civil society organisations to work together to develop a comprehensive approach to strategising drone warfare that maximises the benefits of this technology while minimising the potential risks and drawbacks. By developing a comprehensive approach to drone warfare, India can enhance its military capabilities and contribute to global security efforts. In all, India would need to adopt a strategic approach to drone warfare, that would help the nation to maximise the benefits of this technology while minimising the potential risks and drawbacks.

6.3 Recommendations

6.3.1 Doctrinal Adoption of Drones: The air power doctrine of the Indian Air Force is the datum for the utilisation of assets for modern aerial warfare and also for synthesizing the requirements of the technology and equipment for the air force. It is certain that the technologies that carry importance in the doctrine will surely be pursued and utilised in aerial warfare. Thus, the first recommended step to achieving drone warfare capability is to doctrinally adopt military drones giving them due importance in aerial warfare.

6.3.2 Specify Use of Drones in Aerial Warfare: A clear and comprehensive strategy must be developed for how drones will be used in aerial warfare. This should include the specific

roles and missions that drones will be used for, the types of drones that will be acquired, and the training and support required for drone operators. India should also collaborate with its allies to develop a coordinated approach to drone warfare. This can include sharing intelligence, coordinating operations, and developing joint training exercises to enhance interoperability.

6.3.3 Acquire Appropriate Drone Technology: India should acquire appropriate drone technology that fits its strategy and mission requirements. This can include fixed-wing drones, multi-rotor drones, or hybrid drones depending on the mission profile. The acquisition of this technology will be an interim measure till the indigenous development process takes off well. This will also ensure a good insight into the existing military drones of the world that will further help create a favorable indigenous development environment. To build a global network of drone warfare capabilities, India should develop international partnerships with other countries that are building drone warfare capabilities. This can include collaborating on research and development projects, sharing intelligence and best practices, and coordinating on joint initiatives.

6.3.4 Invest in Research and Development: To stay ahead of the curve in drone technology, India should invest in research and development of new drone capabilities, such as longer range, increased payload, and improved autonomy while at the same time concentrating on upgrading the existing technologies in this field. For this, India should foster partnerships with private industry to leverage their expertise and resources in drone technology. This could include partnering with drone manufacturers and technology companies to develop custom drone solutions tailored to India's specific needs.

6.3.5 Develop Indigenous Drone Technology: India should focus on developing indigenous drone technology to reduce its dependence on foreign drone technology. There is a need to foster a culture of innovation and experimentation within its drone program. This can include encouraging experimentation with new drone technologies, developing new tactics and techniques for drone operations, and fostering a spirit of creativity and risk-taking among drone operators and developers. This will not only strengthen its drone capabilities but also boost its domestic technology industry.

6.3.6 Develop a Robust Training Program: Training is a critical component of building a drone warfare capability. India should develop a robust training program that covers all aspects of drone operations, including mission planning, flight operations, payload operations, and maintenance. This training should be ongoing and regularly updated to reflect the latest advancements in drone technology and tactics.

6.3.7 Leverage Artificial Intelligence (AI) and Machine Learning (ML): AI and ML can play a significant role in enhancing drone warfare capabilities. India should leverage these technologies to develop more sophisticated drone capabilities, such as autonomous decision-making, predictive maintenance, and real-time analytics. India should also establish partnerships with academia and research institutions to access the latest research and developments in drone technology. These partnerships can help India stay on the cutting edge of drone technology and leverage the expertise of leading researchers and academics.

6.3.8 Integrate Drones into Joint Operations: Drone operations are inherently complex and require effective communication and coordination between different branches of the military.

India should ensure that its drone operations are well-coordinated with other military assets, including ground troops, air support, and artillery, to maximise their effectiveness in combat. Drones should also be integrated into joint operations to maximise their effectiveness in combat. India should develop joint operational doctrines that outline how drones can be used in conjunction with other military assets, such as ground troops and air support.

6.4 Recommendations for Further Study

The following areas that will have a bearing on the use of military drones in India are recommended for further study:

6.4.1 Counter-drone capabilities: While India is building its own drone warfare capability, it's important to also consider the potential threat of enemy drones. India would need to incorporate counter-drone capabilities into its drone warfare program to detect and neutralize enemy drones.

6.4.2 Guidelines for the Use of Drones in Warfare: To ensure that drone operations are conducted in accordance with international laws and ethical standards, India would need to establish clear guidelines for the use of drones in warfare, including rules of engagement, target selection, and collateral damage mitigation.

6.4.3 Drone Cybersecurity Program: Drones are vulnerable to cyber-attacks, which can compromise their operations and data. India needs to study and develop a robust cybersecurity program for its drone fleet to protect it against cyber threats and ensure that drones are always mission-ready.

REFERENCES

- Ann Rogers, John Hill. 2014. *Unmanned: Drone Warfare and Global Security*. Pluto Press.
- Ansari, Usman. "Pakistan Boosts Defense Budget by Nearly 6%." *Defense News*, June 11, 2022. <https://www.defensenews.com/global/asia-pacific/2022/06/10/pakistan-boosts-defense-budget-by-nearly-6/>.
- Armed drone makes a huge impact in Africa | Times Aerospace. "Armed Drone Makes a Huge Impact in Africa | Times Aerospace," n.d. <https://www.timesaerospace.aero/features/defence/armed-drone-makes-a-huge-impact-in-africa#:~:text=Renewed%20hostilities%20between%20Armenia%20and,platform%20against%20Armenian%20ground%20forces.>
- Beeri, Tal. 2021. *Iran's UAV Army: A Global Threat*. Alma Research and Education Centre.
- Boyle, Michael J. 2020. *Drones And Terrorism: Asymmetric Warfare And The Threat To Global Security*. Oxford University Press.
- BYJUS. "List of Neighbouring Countries of India - Country Capital, Map & Facts," September 6, 2020. <https://byjus.com/govt-exams/neighbouring-countries-of-india/>.
- Chamber of Indian Micro Small & Medium Enterprises (CIMSME). "Chamber of Indian Micro Small & Medium Enterprises (CIMSME)." Accessed February 5, 2023. https://www.indiansmechamber.com/challenges_to_msme.php.
- Chandler, Katherine. 2020. *Unmanning: How Humans, Machines and Media Perform Drone Warfare*. Rutgers University Press.
- Col RC Srikanth, "UAV Swarms", War College Journal, December 2014
- David Cortright, Rachel Fairhurst. 2015. *Drones and the Future of Armed Conflict: Ethical, Legal, and Strategic Implications*. The University Of Chicago Press.
- Drone Industry Insights. "China Drone Market Report 2019-2024 – Drone Industry Insights," n.d. <https://droneii.com/product/chinese-drone-market-report>.
- Dixon, Robyn. "Azerbaijan's Drones Owned the Battlefield in Nagorno-Karabakh — and Showed Future of Warfare." *Washington Post*, November 11, 2020. https://www.washingtonpost.com/world/europe/nagorno-karabakh-drones-azerbaijan-aremenia/2020/11/11/441cbcd2-193d-11eb-8bda-814ca56e138b_story.html.
- Edward Wong, "Hacking U.S. Secrets, China Pushes for Drones," *New York Times*, 20 September 2013.

- Encyclopedia Britannica. "India | History, Map, Population, Economy, & Facts," n.d. <https://www.britannica.com/place/India>.
- Encyclopedia Britannica. "Lin Biao | Chinese Military Leader." Accessed February 5, 2023. <https://www.britannica.com/biography/Lin-Biao>.
- Fars News Agency. 2021. "The Iranian Drone Threat." *United Against Nuclear Iran*, April: 51.
- Fowler, Mike. 2014. "The Strategy of Drone Warfare." *Journal of Strategic Security*, Vol. 7, No. 4, *Special Issue: Future Challenges in Drone Geopolitics (Winter 2014)*, pp. 108-119 (14 pages) 14.
- Frantzman, Seth J. 2021. *Drone Wars: Pioneers, Killing Machines, Artificial Intelligence, and the Battle for the Future*. Bombardier Books.
- Ganguly, Sumit. "Why the India-Pakistan Rivalry Endures." *Foreign Policy*, December 11, 2022. <https://foreignpolicy.com/2022/12/11/india-pakistan-complex-rivalry-mohan-conflict-politics/>.
- González, Roberto J. "Drones over Ukraine: What the War Means for the Future of Remotely Piloted Aircraft in Combat." *The Conversation*, February 23, 2023. <http://theconversation.com/drones-over-ukraine-what-the-war-means-for-the-future-of-remotely-piloted-aircraft-in-combat-197612>.
- Goppel Anna. 2013. *Killing Terrorists: A Moral and Legal Analysis*. De Gruyter
- Grossman, Nicholas. 2018. *Drones And Terrorism: Asymmetric Warfare And The Threat To Global Security*. I.B. Tauris, Bloomsbury.
- Gusterson, Hugh. 2016. *Drone: Remote Control Warfare*. The MIT Press.
- Hambling, David. "DARPA Starts Work On LongShot Air-To-Air Combat Drone." *Forbes*, February 9, 2021. <https://www.forbes.com/sites/davidhambling/2021/02/09/darpa-starts-work-on-longshot-air-to-air-combat-drone/>.
- Haivision. "Intelligence, Surveillance, Reconnaissance (ISR)." Accessed November 25, 2022. <https://www.haivision.com/resources/streaming-video-definitions/isr-intelligence-surveillance-reconnaissance/>.
- IISS. "Learning the Lessons of Nagorno-Karabakh the Russian Way," n.d. <https://web-opti-prod.iiss.org/online-analysis/online-analysis/2021/03/lessons-of-nagorno-karabakh/>.
- Inc., US Legal. "Battle Damage Assessment (Military Law) Law and Legal Definition | USLegal, Inc." Battle Damage Assessment (Military Law) Law and Legal Definition | USLegal, Inc. Accessed November 25, 2022. <https://definitions.uslegal.com/b/battle-damage-assessment-military-law/>.

- Indian Air Force. 2012. *Doctrine of the Indian Air Force*. New Delhi, India: Directorate of Operations IEW, IAF.
- India vs Pakistan: Military strength and arsenal | News | Al Jazeera. "India vs Pakistan: Military Strength and Arsenal," February 26, 2019. <https://www.aljazeera.com/news/2019/2/26/india-vs-pakistan-military-strength-and-arsenal>.
- IoT Agenda. "What Is a Drone? - Definition from WhatIs.Com," December 1, 2021. <https://www.techtarget.com/iotagenda/definition/drone>. John Kaag, Sarah Kreps. 2014. *Drone Warfare*. Polity Press.
- Jash, Amrita. "China's 2022 Defense Budget: Behind the Numbers." Jamestown, April 29, 2022. <https://jamestown.org/program/chinas-2022-defense-budget-behind-the-numbers/>.
- Kaya, Karen. 2022. *Turkey as a Drone Superpower: A Case Study of a Mid-Size Power Driving the Operational Environment*. Foreign Perspective, Foreign Military Studies Office.
- Lisa Parks, Caren Kaplan. 2017. *Life in the Age of Drone Warfare*. Duke University Press.
- Laird, Robbin. "The Strategic Shift and Dynamic Targeting: Meeting the Challenge - Second Line of Defense." Second Line of Defense, May 28, 2020. <https://sldinfo.com/2020/05/the-strategic-shift-and-dynamic-targeting-meeting-the-challenge/>.
- Mad Scientist Laboratory. "317. Top Attack: Lessons Learned from the Second Nagorno-Karabakh War | Mad Scientist Laboratory," April 1, 2021. <https://madsicblog.tradoc.army.mil/317-top-attack-lessons-learned-from-the-second-nagorno-karabakh-war/>.
- Military Strategy Magazine. "Drones in the Nagorno-Karabakh War: Analyzing the Data - Military Strategy Magazine," n.d. <https://www.militarystrategymagazine.com/article/drones-in-the-nagorno-karabakh-war-analyzing-the-data/>.
- MoD India. "Defence Gets Rs 5.94 Lakh Crore in Budget 2023-24, a Jump of 13% over Previous Year." Accessed February 2, 2023. pib.gov.in/Pressreleaseshare.aspx?PRID=1895472.
- Narang, Rajiv Kumar. 2017. "Indigenisation of UAVs by India and Its Challenges." *Journal of Air Power and Space Studies*.
- Newcome, L. 2004. *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*. Pen & Sword.

- Nichols, R. K. et al. UAS Intelligence, Surveillance and Reconnaissance (ISR) – Unmanned Aircraft Systems in the Cyber Domain. Accessed November 25, 2022. <https://kstatelibraries.pressbooks.pub/unmannedaircraftsystems/chapter/chapter-10-uas-intelligence-surveillance-and-reconnaissance-isr/>.
- Northrop Grumman. “The Need for SEAD / DEAD,” n.d. <https://www.northropgrumman.com/what-we-do/advanced-weapons/the-need-for-sead-dead>.
- Ozdemir, Gloria Shkurti. 2022. "Conceptualising the Rise of Turkiye as a Drone Power." *Strategic Papers: Arab Centre for Research & Policy Studies*, September 19: 12.
- Pakistan Air Force (2023). “Pakistan Air Force (2023).” Accessed February 5, 2023. <https://www.wdma.org/pakistan-air-force.php>.
- Reid, David. “Saudi Aramco Reveals Attack Damage at Oil Production Plants.” CNBC, September 20, 2019. <https://www.cnbc.com/2019/09/20/oil-drone-attack-damage-revealed-at-saudi-aramco-facility.html>.
- Rubin, Michael. “A Short History of the Iranian Drone Program.” American Enterprise Institute, 2020. <http://www.jstor.org/stable/resrep26682>.
- Scahill, Jeremy. 2016. *The Assassination Complex: Inside the Government’s Secret Drone Warfare Program*. Simon & Schuster.
- Shah, Sabir. “An Overview of Pakistan’s Naval Prowess.” An overview of Pakistan’s naval prowess, February 5, 2023. <https://www.thenews.com.pk/print/790270-an-overview-of-pakistan-s-naval-prowess>.
- Sibal, Kanwal. “India and Its Neighbours - Indian Defence Review.” India and its neighbours - Indian Defence Review. Accessed February 5, 2023. <http://www.indiandefencereview.com/interviews/india-and-its-neighbours/>.
- Slogget, Dave. 2015. *Drone Warfare: The development of unmanned aerial conflict*. Skyhorse Printing Press.
- SWIR For Intelligence & Surveillance (ISR) | Sensors Unlimited. “SWIR For Intelligence & Surveillance (ISR) | Sensors Unlimited,” n.d. <https://www.sensorsinc.com/applications/military/swir-for-isr>.
- The Nagorno-Karabakh Conflict: A Visual Explainer | Crisis Group. “The Nagorno-Karabakh Conflict: A Visual Explainer,” October 26, 2020. <https://www.crisisgroup.org/content/nagorno-karabakh-conflict-visual-explainer>.
- Vyas, Kashyap. “A Brief History of Drones: The Remote Controlled Unmanned Aerial Vehicles (UAVs).” A Brief History of Drones: The Remote Controlled Unmanned Aerial Vehicles (UAVs), June 29, 2020. <https://interestingengineering.com/innovation/a-brief-history-of-drones-the-remote-controlled-unmanned-aerial-vehicles-uavs>.

Yuan, Shawn. "Just How Strong Is the Chinese Military?" Just how strong is the Chinese military? | Military News | Al Jazeera, October 29, 2021. <https://www.aljazeera.com/news/2021/10/29/just-how-strong-is-the-chinese-military>.

Zenko, Sarah Kreps and Micah. 2014. "The Next Drone Wars: Preparing for Proliferation." *Foreign Affairs*, Vol. 93, No. 2 (MARCH/APRIL 2014), pp. 68-74, 75-79 (12 pages) 12.

SURVEY QUESTIONNAIRE

Introduction

My name is Group Captain Vijay Kumar Gupta. I am from the Indian Air Force undergoing a National Security and Strategy course and pursuing Masters of Arts at National Defence College-Kenya. As part of academic requirement for the award of the degree, I am undertaking a research study on “Strategising Use of Drones in Modern Aerial Warfare for Indian Sub-Continent”. The questionnaire voluntarily seeks information pertaining to the study and will be treated with the highest standards of research ethics and confidentiality. The information obtained will not be distributed nor shared with unauthorised persons or agencies and will be used purely for the purpose of research work.

Demographic Data

- 1 Age
- 2 Level of Education
- 3 Current Place of Residence
- 4 Association with Aerial Warfare
- 5 Knowledge about Military Drones

Evolution of Drones

- 6 When do you think drones first started getting used in aerial warfare?
- 7 During which period, drones have been used maximum in proportion to manned aircraft?
- 8 How informed are you about United States’ Global War on Terror?

9 In your opinion, how adequate and timely is the investment by various nations in drone warfare technology?

10 In your opinion, do drones have the capability to replace manned aircraft in future for aerial warfare?

Role and Tasks of Drones

11 Are drones capable of performing the roles of manned aircraft?

12 Which role is best suited to Drones in modern aerial warfare?

13 What is the major limitation of armed drones in Modern Aerial Warfare?

14 What is the major strength of armed drones in Modern Aerial Warfare?

15 In your opinion, in what additional roles, drones are likely to be used in future?

Doctrinal absorption of drones in Modern Military Combat

16 Are drones necessary components of the arsenal of a strong military?

17 In your opinion, have countries with drone inventory strategised their use adequately?

18 Do you think that developing countries like India with good military capability need to increase the use of drones in modern aerial warfare?

19 Do you think that doctrinal adoption of drones is necessary to strategise their use and enforce capability build up?

20 Do you think drones have been included adequately in the Air Power doctrines of developing countries with strong militaries?

-----End-----

Thank You