CHAPTER FOUR

AIR POWER IN THE 1991 WAR

Let your rapidity be that of the wind, your compactness that of the forest. In raiding and plundering be like fire, in immovability like a mountain. Let your plans be dark and impenetrable as night, and when you move, fall like a thunderbolt.

-- Sun Tzu, *The Art of War* (490 BC)

The original scheme of study was to analyse and evaluate the use of new technology air power in October 1973 War. During the period of study, however, the Gulf War of 1991, which had factored in the lessons of October 1973 War, became relevant to this study and is covered in this concluding chapter, along with a brief description of the 1982 war in the Lebanon.

Section 1 - The War in Lebanon, 1982

Introduction

More than twenty years ago, the Arab-Israeli War of 1973 for the first time saw intense use of high technology
weapons systems like precision guided missiles, electronic warfare equipment and satellite based surveillance systems which proved decisive in the success of air operations. During the last two decades, there has been an exponential rise in the operational capabilities of new technology weapons particularly those integrated for use with air forces. Electronic warfare in the electro-magnetic spectrum, is termed as a 'silent and invisible war' in the 'fourth dimension', and it has become an essential component of all warfare whether on land, at sea, or in the air. The face of warfare has changed radically during the last twenty years. During the conflict in Lebanon in 1982 including the air battles over the Bekaa Valley the Israeli Air Force scored unprecedented victories with a loss rate in its favour of 50:1. This was made possible by the widespread, co-ordinated use of ECMs and weapon systems against enemy command, control and communications systems.¹

Israel exploited its superior electronic warfare capability during the war in Lebanon in 1982 to destroy

¹ Mario de Arcangelis, Electronic Warfare: From the Battle of Tsushima to the Falklands and Lebanon Conflicts (Dorset, 1985), p. 277.
Syrian missile sites in the Bekaa Valley and soon after, shot down a large number of Syrian aircraft without any loss to itself. During these air battles, the Israelis employed unmanned air vehicles (UAV) for surveillance of Syrian positions and SAM sites on a real-time basis. According to a British defence analyst, "while Britain fought yesterday's war in the Falklands, the Israelis fought tomorrow's war in the Lebanon." The Lebanon war could be called the new face of war, in which the central and the dominant theme was electronic warfare. US Secretary of Defence Casper Weinberger, commenting on these wars, said that the decisive effect of new technology weapons was clearly demonstrated by the British in the Falklands and the Israelis in the Lebanon.

The Lebanon conflict was a mid-way landmark between the October 1973 Arab-Israeli war and the Gulf War of 1991 between Iraq and the Multi-National Forces (MNF). The lessons of 1973 war were used by Israel to plan

3 ibid.
4 ibid.
the strategy and the use of weapons. The strategy and
the conduct of war in the Lebanon was carefully analysed
by the US and other countries to draw necessary lessons
for their own benefit.

Conduct of operations.

At 1100 hrs on June 6, 1982, Israel mounted a large
scale assault across its northern border into Lebanon
which was spearheaded by Israeli armour and mechanised
formations against PLO held positions in southern Lebanon.
This operation was called by the Israelis "Peace for
Galilee" and it was to be limited in its objective of
clearing the area of the PLO upto Litany River, a distance
of only 40 Km from the border. 5

The assault by Israel was carried out by an armoured
force of eight divisional groups against the PLO which
had about 15,000 fighters and the Syrian Army in Lebanon
which totalled some 30,000 troops. The three-pronged attack
by Israel was fairly successful in the coastal and the
central sector but it met stiff resistance in the eastern
sector where the Syrian Army with its anti-tank missiles

5 Eric Hammel, The Root: The Marines in Beirut August 1982-
caused a slowing down of the Israeli advance. In this heavy fighting between the Israeli armour and the Syrian defending army, the Israeli Air Force became a central factor. In this crucial battle in the eastern sector of Lebanon, between the advancing Israeli armour and the defending Syrian forces, the Syrian Air Force had to intervene in the fighting. This resulted in the Israeli Air Force joining in the fray, and in the ensuing dogfights six Syrian aircraft were shot down.

The Syrian ground based air defence systems which had been strengthened to counter the threat posed by the Israeli Air Force over the Bekaa Valley, and comprised 15 SA-6, two SA-3 and two SA-2 missile batteries with some 200 ready to launch missiles posed a serious threat to Israeli aircraft. However, the Israeli Air Force had learnt its lesson well from its experiences of the 1973 War when it had suffered heavy losses from Soviet supplied SAMs used by Egypt and Syria. In an integrated attack

on the Syrian missile sites in the Bekaa Valley, Israeli long-range artillery and surface-to-surface rockets closely followed by Israeli fighter bomber aircraft destroyed seventeen Syrian SAM batteries and damaged two without losing a single aircraft. The Syrian response was to send up about sixty Syrian fighters of MiG-21 and MiG-23 type to fight and gain command of the air over the Bekaa Valley from the Israeli Air Force. This resulted in the most intense and far-reaching dogfights since the Second World War. After these air battles the Israelis claimed to have shot down 29 Syrian aircraft without themselves suffering any losses. On the other hand, Syria claimed to have downed 26 Israeli planes and having lost 16 aircraft. Soon after, when the Syrians tried to reinforce the eastern sector with additional missile batteries, tanks, and troops to halt the advancing Israeli formations, and to strengthen air defence capability they were again attacked by the Israeli Air Force and in air-to-air fighting lost 26 Migs and two helicopters.

By June 12, when a cease-fire had come into effect it was reported that Syria had lost in air combat 80 aircraft of different types. Israel did not admit any

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8 ibid.
losses in air combat but accepted the loss of one A-4 Skyhawk and two helicopters by ground fire.\textsuperscript{9}

Outcome of the War

Israel achieved it original objectives of a limited offensive upto Litany River and cleared the area of PLO concentrations. It occupied the security zone of 40 Km inside Lebanon within three days of commencing the operation 'Peace for Galilee'. It achieved all this with very few casualties which totalled 25 dead, 96 wounded, and seven missing in action. It was a great victory for Israeli strategy and conduct of the operation. However, this victory was turned into a tragic quagmire, when General Sharon decided to push ahead to Beirut and, after defeating the PLO and the Syrian forces, to hand over the country to Lebanese Christian factions. The subsequent Israeli siege of Beirut and the evacuation of PLO command headquarters from there to Tunis, while achieving the hidden agenda of General Sharon got Israel involved in a campaign in Lebanon from which it found itself difficult to extricate and suffered heavy casualties.\textsuperscript{10}

\textsuperscript{9} ibid, p. 183.

Analysis of Air Operations

Like the War of 1973, the conflict in Lebanon, once again, was a clash of western and Soviet technologies. That the lessons of 1973 were well learnt was evident in the results of air operations. While in 1973, 50 Israeli aircraft were shot down by Egyptian and Syrian ground-based anti-aircraft systems in the first three days of the war, in 1982, the Israeli Air Force destroyed the entire SAM system of Syrian air defence without losing a single aircraft.¹¹ The greatest asset Israel had was the state of complete air superiority established over the Lebanese air space by the Israeli Air Force. Drawing their own conclusions from the lessons of the 1973 War, the Syrians had relied mainly on their ground-based air defence systems of SAMs and anti-aircraft artillery to counter the Israeli Air Force which had suffered high attrition from these weapons at the time. However, the total destruction of SAMs in the Bekaa Valley on June 9 by the Israeli Air Force put Syria off balance. Israel's victory in the air appears to have been a major factor in the decision of the Syrian government to seek a cease-fire. "The developments in the air undoubtedly led to

¹¹ Herzog, n. 6, p. 363.
the Syrian decision not to widen the scope of the fighting to the Golan Heights, and also to cut their losses in the Beirut area."

In evaluating the results of the Bekaa air battle, General Herzog says that, "sight should not be lost of the fact that the confrontation which took place was not merely between aircraft and the missile. It was one between two complex technological systems, including most modern and highly sophisticated air control and electronic communications equipment. These two systems were tested in battle, both in the destruction of the missiles and in one of the major air battles in modern history. The control and direction of such operation, and the orchestration required for all the elements involved is highly complex, and thus despite the very sophistication of the equipment the human element still remains a dominant one."

The Bekaa Valley air battle became one of the most discussed air operations in the history of modern warfare. The strategy and tactics included the use of E-2C Hawkeye

12 ibid, p. 364.
13 ibid, p. 365.
aircraft for surveillance which was capable of handling 150 combat targets and track Syrian aircraft that were still on the runway. Israel is reported to have used Boeing 707, described as a flying fortress, which emitted electronic signals in every direction to disrupt radar systems of the air defence network. These electronic emissions blocked the communications channels between the Syrian pilots and their ground controllers making these aircraft totally blind. In such a situation, they were shot down in large numbers.\textsuperscript{14}

There were several unmanned air vehicles (UAV) or remote piloted aircraft (RPVs) designed and produced in Israel for transmission of television images of the battlefield in real-time used for precise tracking of targets and for disruption of radar systems. Israel, in addition, developed an improved version of US Shrike missile, known as the Purple Fist, to destroy the radar of missile batteries. It is an air-to-surface missile that is capable of detecting the radar beam and rides it to the missile site, hitting the centre of the battery destroying the fire-control station and the operations

\textsuperscript{14} Eliezer Cohen (Col), \textit{Israel's Best Defence: The First Full Story of the Israeli Air Force} (New York, 1993), pp. 469-470.
centre. This advanced Shrike was reported to be more intelligent than the early versions which could be confused and neutralised by switching of the radar. The new version has a memory cell, and even when the radar beam disappears it continues to fly towards the radar and destroys it even when the radar is on the move.¹⁵

The Bekaa Valley air operations were a clear indication of the value of an effective battle management system. Israel was able to destroy the Syrian SAMs with their integrated air defence suppression network. There was an array of sensors available to Israeli commanders to provide them with detailed coverage of the Syrian air defence activity. There were electronic intelligence systems to monitor the radar and radio signals of Syrian air defence units.¹⁶ These were supported by mini-RPVs, long-range cameras, and agents on the ground. The Israelis used all the intelligence given by these different sources to adopt the best tactics suited to each occasion. They could either use airborne or ground based electronic counter measures or mount air attacks

¹⁵ ibid, p. 471.
or use artillery fire to neutralise Syrian air defence batteries.

Lessons From the Lebanon War

One of the most important lessons emerging out of the war in Lebanon is the Israeli exploitation of C3I systems in their air and ground operations with excellent results. This was particularly significant in a co-ordinated employment of aircraft and UAVs for real-time surveillance and in attacks on Syrian SAMs in the Bekaa Valley. Using the C3I system made it possible for Israel to obtain all essential information and then pass it on to those concerned without any delay. The integrated use of ECM against enemy command, control, and communications was another factor which contributed to their success. "The Israelis demonstrated the highest degree of co-ordination between UAVs, guidance and control of their own aircraft using E-2cs, jamming of communications and radar using the Boeing 707 and, finally, the actual means of material destruction themselves, such as aircraft armed with anti-radar missiles, or UAVs full of explosives, targetted against enemy radars and SAM-6 batteries."17

17 Arcangelis, n. I, pp. 277-278.
The conflict in the Lebanon was a significant landmark in the evolution of new technology warfare, which had tremendous impact on the employment of air power. The entirely new technologies of precision guided weapons, electronic warfare, satellite based surveillance and communications capability, and use of UAVs/RPVs for real-time intelligence and communication have engendered a new kind of war which is highly effective in achieving the objectives if used in a co-ordinated manner. The new technologies have fundamentally, enhanced the performance of weapon systems resulting in greater accuracy and lower casualties. These weapons have become more discriminate and the 1,000 bomber raids of World War II, totally destroying cities, have become obsolete. However, the cost effective use of new technology weapons depends on appropriate doctrines, strategies and suitable tactics which fully exploit the capabilities of the new weapon systems. Almost ten years later, in the Gulf War of 1991, the lessons from the conflict in the Lebanon had been fully absorbed.

Section 2-Air War in the Gulf, 1991

Introduction

The war in the Gulf in 1991, fought between Iraq and the Multi National Forces (MNF) led by the United
States has been called an air war because it was the air power that began the war and after 45 days air operations brought about a withdrawal of Iraqi troops from Kuwait thus achieving the political objective of the war. In the last 100 hours of the war the MNF ground forces mounted an assault on retreating Iraqi troops and occupied Kuwait and the southern part of Iraqi territory. Air Vice Marshal R.A. Mason of the Royal Air Force says that the Gulf War marked the apotheosis of twentieth-century air power.\textsuperscript{18} Richard P. Hallion, describing the significance of air power in the Gulf War, says ``Simply (if boldly) stated, air power won the Gulf War. it was not the victory of any one service, but rather the victory of Coalition air power projection by armies, navies and air forces.''.\textsuperscript{19}

Background to the Gulf War

The Iran-Iraq War which began in September 1980 and ended with a cease-fire in July 1989, was a war that Iraq almost lost. It was expected after the war that

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\textsuperscript{19}
the Iraqi Leadership would have learnt a lesson and would try to rebuild its country which had suffered massive casualties and economic devastation. However, this was not to be, and the Iraqi people were destined to suffer further hardship and deprivation due to the aggressive policies of their leader, President Saddam Hussein.

As regards Iraqi intentions in Kuwait, there had been several moves by Iraq in the past to claim Kuwait as a part of Iraq on historical grounds. In 1958, at the height of the Lebanon crisis, US Marines had to be rushed into the Persian Gulf to counter the threat to Kuwait from the new Iraqi regime. When Iraq was again on the verge of attacking Kuwait in 1961, a combined Arab-British force was airlifted to Kuwait to foil Iraqi plans. By the middle of 1990, it appeared that the likelihood of an Iraqi invasion of Kuwait could not be ruled out, but a number of Middle East experts did not realise the gravity of the situation even in late July, when according to reports, Iraqi tanks were moving towards the border with Kuwait. At this stage Iraq owed $40 billion in war debts mostly to Kuwait and wanted to improve its access to the Gulf by acquiring Kuwaiti coastal areas by negotiations if possible, by force if necessary. By this time Iraq had powerful and combat-tested armed
forces with first class military equipment mainly supplied by the Soviet Union. Some impression of its military buildup can be had from the following table.  

Table 1: Iraqi Force Structure, 1980-1990

<table>
<thead>
<tr>
<th>Force structure</th>
<th>1980</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Troops</td>
<td>180,000</td>
<td>900,000</td>
</tr>
<tr>
<td>Tanks</td>
<td>2,700</td>
<td>5,700</td>
</tr>
<tr>
<td>Artillery pieces</td>
<td>2,300</td>
<td>3,700</td>
</tr>
<tr>
<td>Combat Aircraft</td>
<td>332</td>
<td>950</td>
</tr>
</tbody>
</table>

There were several other disputes between Iraq and Kuwait like the one over the boundary, and over excessive production of oil, as well as the dispute over the two islands of Warbah and Bubiyan which had not been settled despite several meetings between the leaders of the two countries.

Another and more compelling reason for Iraq's focus on Kuwait was Kuwaiti wealth with financial reserves estimated to be close to $100 billion. Iraq also accused Kuwait for stealing $2.4 billion worth of oil from the

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20 ibid, p. 128.
al-Rumaila oilfield situated in the disputed border region.21

Iraqi Invasion and its Aftermath

Iraqi armoured forces crossed into Kuwait at 2 AM on the morning of August 2, 1990. Iraqi armour was supported by artillery and air force and made rapid progress encountering hardly any resistance from Kuwaiti forces. Kuwait city was occupied the same day and all Kuwaiti resistance came to an end.22 After annexation of Kuwait by Iraq, Saudi Arabia agreed to have US and allied forces to reinforce Saudi defences to prevent further Iraqi advance towards Saudi Arabia or the Gulf. The Operation Desert Shield which began on August 8 continued for the next six months and built up the strength of coalition forces to the level needed for achieving a distinct edge over Iraqi forces. This period was used to organise a coalition of almost 30 countries against Iraq and obtain the sanction of the United Nations to use all means, including armed forces, to evict Iraq from Kuwait. The following table gives a list of countries

22 Hallion, n. 19, p. 134.
which provided forces to the Coalition against Iraq.  

<table>
<thead>
<tr>
<th>Country</th>
<th>Troops/Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>300 Mujaheddin</td>
</tr>
<tr>
<td>Bahrain</td>
<td>3,500 troops</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2,000 troops</td>
</tr>
<tr>
<td>Czechoslovakia</td>
<td>350 medical and chemical warfare troops.</td>
</tr>
<tr>
<td>Egypt</td>
<td>40,000 troops; 400 tanks</td>
</tr>
<tr>
<td>France</td>
<td>20,000 troops; 350 tanks; 40 aircraft.</td>
</tr>
<tr>
<td>Italy</td>
<td>8 aircraft</td>
</tr>
<tr>
<td>Kuwait</td>
<td>7,000 troops; 35 aircraft</td>
</tr>
<tr>
<td>Morocco</td>
<td>2,000 troops</td>
</tr>
<tr>
<td>Oman</td>
<td>25,000 troops; 75 tanks; 50 aircraft.</td>
</tr>
<tr>
<td>Pakistan</td>
<td>10,000 troops</td>
</tr>
<tr>
<td>Qatar</td>
<td>7,000 troops; 24 tanks</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>94,000 troops; 550 tanks; 180 aircraft.</td>
</tr>
<tr>
<td>Syria</td>
<td>19,000 troops; 300 tanks</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>40,000 troops; 200 tanks; 80 aircraft.</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>42,000 troops; 200 tanks; 58 aircraft.</td>
</tr>
<tr>
<td>United States</td>
<td>532,000 troops; 2,000 tanks; 1,800 aircraft.</td>
</tr>
</tbody>
</table>

The aircraft strength of the Coalition is given at appendix 'P'. It included 1,838 fighter attack aircraft, 312 aerial refuelling tankers, 234 airlift transports, and 230 aircraft of other types making a grand total of 2,614 aircraft with the Coalition as against about 900 aircraft of all types with Iraq.24

Coalition Objectives and Strategy

The Coalition's military objectives were clearly defined and limited and announced by President Bush just after the commencement of the air campaign. These were ejection of Iraqi forces from Kuwait and the restoration of the legitimate government of Kuwait. President Bush also mentioned that some wider objectives were the destruction of Iraq's nuclear, biological, and chemical weapons producing capabilities, as well as its missile programme. Further, he said that Iraq's artillery and tanks were to be destroyed.25 The Coalition strategy of offensive against Iraq in four phases was as follows:26

24 Hallion, n.19, p.158.
25 Danneuther, n.21, p.46.
Table 3: Phases of Coalition Offensive with Targets

<table>
<thead>
<tr>
<th>Phase</th>
<th>Title</th>
<th>Targets/mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Strategic Air</td>
<td>Iraqi command and control suppression, NBC assets, Republican Guards.</td>
</tr>
<tr>
<td>II</td>
<td>Air supremacy</td>
<td>Defeat Air Force, enemy supply lines.</td>
</tr>
<tr>
<td>III</td>
<td>Battlefield</td>
<td>enemy supply lines, forward deployed NBC assets, Republican Guards.</td>
</tr>
<tr>
<td>IV</td>
<td>Ground Offensive</td>
<td>Liberate Kuwait, destroy Iraqi Ground forces.</td>
</tr>
</tbody>
</table>

The Coalition air operations were planned in three phases. The first phase was to be used to mount air attacks on strategic targets. In the next phase, air power was to suppress air defences in Kuwaiti theatre of operations, and in the last phase air attacks were to be mounted against the Republican Guards and Iraq's Army in Kuwait. The tasks given to the air forces during the strategic operations were based on the concept of five strategic rings. These were: to isolate the Iraqi leadership; degrade key production facilities; disrupt Iraqi
infrastructure via transportation attacks; turn the population and troops against the regime; and destroy offensive and defensive military capability of Iraq. These tasks were to achieve the following strategic objectives.  

1. Seizing and retaining air superiority.
2. The isolation and incapacitation of Iraqi leadership.
3. Destruction of Iraq's nuclear, biological and chemical warfare capability.
4. Elimination of Iraq's offensive and defensive capability.

For the above tasks, the coalition air power had aircraft of several types which included stealth fighter bomber F-117A, B-52 G, EF-III A, EA-6B, F-4G, F-15E, F/A-18, F-IIIF, A-6E, Tornado GRI, F-15C, Tornado F-3, Saudi F-15A, Navy F-14A, In addition, flight refuelling tanker aircraft, E-3B airborne warning and control system (AWACS), E-8A for joint surveillance target attack radar system (JSTARS) for air to ground operations. The total strength of Coalition air forces on the eve of Desert Storm was 2,614 of which 1,990 were American including 450 aircraft

27 Hallion, p. 19, pp. 150-151.
on carriers. Coalition air strength before the Gulf War, 1991, is shown in the table below:

Table 4: Coalition Air Strength before the Gulf War, 1991

<table>
<thead>
<tr>
<th>Country</th>
<th>Fighter/</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Attack</td>
<td>Tanker</td>
</tr>
<tr>
<td>United States</td>
<td>1,323</td>
<td>285</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>276</td>
<td>15</td>
</tr>
<tr>
<td>Great Britain</td>
<td>57</td>
<td>9</td>
</tr>
<tr>
<td>France</td>
<td>44</td>
<td>3</td>
</tr>
<tr>
<td>Kuwait</td>
<td>40</td>
<td>--</td>
</tr>
<tr>
<td>Canada</td>
<td>26</td>
<td>--</td>
</tr>
<tr>
<td>Bahrain</td>
<td>24</td>
<td>--</td>
</tr>
<tr>
<td>Qatar</td>
<td>20</td>
<td>--</td>
</tr>
<tr>
<td>UAE</td>
<td>20</td>
<td>--</td>
</tr>
<tr>
<td>Italy</td>
<td>8</td>
<td>--</td>
</tr>
<tr>
<td>New Zealand</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Totals</td>
<td>1,838</td>
<td>312</td>
</tr>
</tbody>
</table>

Total does not equal 100 percent due to rounding.


The lessons of the 1973 War and the conflict in the Lebanon in 1982 had an important impact on the shaping of air power strategy and tactics used in the Gulf War 1991. The Coalition forces followed an offensive strategy, while Iraq, despite having highly sophisticated weapons of modern technology, remained on the defensive throughout the war.29

Conduct of Air Operations in the Gulf

According to Mohamed Heikal, an Egyptian journalist and a well known political commentator, "during the night of 16-17 January, a wide range of Coalition aircraft including F-15E, F-IIIIs, F-117s, A-6s, F-4Gs and Tornados GR 1 demonstrated the huge technological advances of recent years in aerial warfare."30

The Coalition air offensive against Iraq targeted in addition to air defence network and command and control centres, electrical supply, water supply, telephone network, petrol refining capacity, main bridges and principal roads.

29 Ibid, p. 83.
The result of this air offensive was to take Iraq back into the age of primitive society from a modern industrialised state. "It was evident that the ground forces were not the main instrument of attack; their role was to finish a task which was almost entirely achieved by the Coalition air power. General Powell, the US Joint Chief of Staff, described the ground offensive as essentially 'a mopping-up operation'. Iraq appeared to have learnt nothing from its experiences against Iran but continued in its largely defensive, unaggressive and mechanical attitude towards modern air warfare."\(^{31}\)

The first coalition air strike over Iraq was mounted with more than 400 aircraft of different types, and included 160 aerial refuelling tankers and C\(^3\)I aircraft with precisely synchronised missions. The first missions of B-52s had taken off from US bases 12 hours before the actual strikes.\(^{32}\)

The first air mission during the war was flown by Apache helicopters which were employed to destroy eight

\(^{31}\) ibid, pp. 386, 387.

radar sites of an early warning network close to the Iraqi border. These radars were located near the border so that they could warn the main radar control stations about incoming raids. Their destruction warned the Iraqi air defence command and control centres. The Iraqi air defence system was activated. However, the electronic warfare systems carried by other Coalition aircraft further reinforced the disorientation caused by the destruction of early warning radars. The main attack was mounted by F-117A 'stealth' aircraft and was supported by cruise missiles. The advantages of 'Stealth' technology are shown in the diagram on the next page. Their targets were main air defence centres and Baghdad. In Baghdad, the aircraft attacked the Presidential Palace, government offices, and the international airport. In all, 56 aircraft are reported to have participated in the first wave. Simultaneously, F-15Es attacked Scud sites in western Iraq. Later, the same day, aircraft attacked electrical power stations, chemical weapon plants, airfields and command headquarters. During the first 24 hours the Coalition air forces had flown 1,300 sorties. Later, sortie rate had increased to 2,000-3,000 per day.\footnote{ibid, p. 301.}
Impact of Stealth Technology

A. Detection Effectiveness against Conventional Aircraft

B. Detection Effectiveness against Stealth Aircraft

The Value of Stealth: Stealth effectively reduces the detection ranges of radar.

Table 5 below gives a list of strategic air targets, their number, and sorties flown for each category.  

<table>
<thead>
<tr>
<th>Target</th>
<th>Number</th>
<th>Sorties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric power</td>
<td>28</td>
<td>215</td>
</tr>
<tr>
<td>Naval</td>
<td>20</td>
<td>247</td>
</tr>
<tr>
<td>National Command authority</td>
<td>26</td>
<td>429</td>
</tr>
<tr>
<td>Air Defence</td>
<td>29</td>
<td>436</td>
</tr>
<tr>
<td>Oil</td>
<td>28</td>
<td>518</td>
</tr>
<tr>
<td>Command, control and Communications</td>
<td>170</td>
<td>601</td>
</tr>
<tr>
<td>Road, rail and bridges</td>
<td>54</td>
<td>712</td>
</tr>
<tr>
<td>Nuclear, biological and chemical</td>
<td>31</td>
<td>902</td>
</tr>
<tr>
<td>Military support</td>
<td>96</td>
<td>2,756</td>
</tr>
<tr>
<td>Short-range ballistic missiles (Scuds)</td>
<td>30</td>
<td>2,767</td>
</tr>
<tr>
<td>Airfields</td>
<td>66</td>
<td>3,047</td>
</tr>
<tr>
<td>Republican Guard</td>
<td>145</td>
<td>5,646</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>723</strong></td>
<td><strong>18,276</strong></td>
</tr>
</tbody>
</table>

34 ibid, p.330.
The Iraqi Air Force remained on the defensive throughout the air campaign despite being equipped with about 700 front-line, mostly Soviet supplied, fighter bomber aircraft which included MiG-21, MiG-23, MiG-25, MiG-27, MiG-29, Su-7, Su-20, Su-22, Su-25, Tu-16, Tu-22 and French Mirage F-1 armed with AM-39 Exocet anti-ship missile. Iraq also possessed a range of stand-off precision guided munitions including AS-30L laser guided smart missile, Soviet AA-6 and AA-7 and French R-530 air-to-air missiles. 35

There were 160 armed helicopters in Iraq's inventory including Mi-24 Hind gunships. For ground-based air defence Iraq had 7,000 anti-aircraft guns, 16,000 SAMs which included SA-2, -3, -6, -7, -8, -9, -13, -14, -16. It also had Franco-German Roland SAM and the US I-Hawk which it had captured in Kuwait. There were 24 main air bases and 30 dispersal bases, all modern airfields with hardened aircraft shelters. Its command, control and communications (C3) system was reported to be of the latest Soviet design with layered air defences comprising a centralised air defence headquarters, sector control centers, radars, SAMs, AA artillery and fighter bases. In addition, Iraq

35 Hallion, n. 19, pp. 146, 147.
had 600 improved Scud B surface-to-surface missiles.\textsuperscript{36} Iraqi military strength in December 1990 is shown at Appendix `Q'.

Iraq's strategy at this stage of the war depended mainly on its extensive ground-based air defences which were expected to absorb the initial air strikes of the Coalition forces. Iraq's own air capability was to be kept in reserve for use during the land war; meanwhile, Iraq would extend the war to Israel and Saudi Arabia by using the Scud B SSM. Iraq's confidence was based on an extensive network of air defence elements of radars, SAMs, AA artillery and Mirage fighter interceptors which were fully integrated and centrally controlled. But the weak points in this intensive network were the control centres whose destruction could neutralise the entire air defence.\textsuperscript{37}

Reporting the first phase of the Coalition air campaign, \textit{Aviation Week and Space Technology} described the initial attacks as joint effort of the US, Saudi Arabian, British and Free Kuwaiti air forces before

\textsuperscript{36} ibid.

\textsuperscript{37} Freedman and Karsh, n.32, p. 302.
3 a.m. local time on January 17, within 24 hours of the expired UN deadline for Iraqi withdrawal from Kuwait. The Iraqis were totally surprised by the successive waves of air strikes made by hundreds of aircraft and Tomahawk cruise missiles. During the first few hours the strike aircraft destroyed Iraqi command and control centres, Scud missile sites, radars, airfields, and aircraft.

The Iraqi response to these air attacks was to launch Scud missiles against Saudi Arabia and Israel. According to the Pentagon, Iraq launched seven Scuds against Israel and one against Saudi Arabia. Some of these Scuds were intercepted and destroyed by US Army Patriot air defense missiles. Scuds fired from western Iraq hit Tel Aviv and Haifa causing extensive damage and injuring about seven persons.38

US Air Force F-117A stealth aircraft attacked targets in Iraq in the early morning darkness on January 17. The other aircraft which were used in the initial phase included US Air Force F-15Es, F-111Fs, F-16A/Cs, F-4G Wild Weasel defence suppression aircraft, A-10s and B-52Gs.

bombers. A-6Es, F/A-18s, A-7Es and AV-8Bs from the US Navy and Marine Corps flew night missions and struck targets in Iraq. AH-64 Apache helicopters of the US Army 'performed very well in a relatively limited role' according to Pentagon.

Strike forces were escorted and combat air patrol was provided by US Navy F-14s, and Marine F/A-18s and Air Force F-15Cs. Electronic combat support for Desert Storm operations was provided by Air Force EF-III and Navy EA-6B Jammers. E-3A Sentry and E-2C Hawkeye airborne warning and control system (AWACS) provided command and control of the operations. Aerial refuelling was carried out by Air Force KC-10 and KC-135 and Navy KA-6 tanker aircraft for strike missions.

During the early phase Coalition casualties were light; in the first two days two British Tornados, one US Navy F/A-18 and one A-6E and an Air Force F-15E were reportedly shot down over Iraq. 'There have been some air engagements, but there has been no major air battle'. according to a Pentagon official.\textsuperscript{39} To provide bomb damage assessment as well as to keep track of troop movements

\textsuperscript{39} ibid.
in Kuwait, the United States had inducted into the area US Air Force E-8 Joint Surveillance Target Attack Radar System (JSTARS).

During the first three weeks of operation Desert Storm, air-to-air combat was limited and it was reported that 33 Iraqi aircraft and two helicopters were shot down by Coalition fighters. According to military planners the reason for the limited number of air engagements was the total air supremacy achieved by the Coalition air forces within the first few days. "We damaged the runways, crippled his command and control network, and basically were able to rule the skies relatively quickly,'" said one US Air Force pilot. During the same period, no Coalition aircraft were downed in air-to-air combat, but 23 losses were reported in combat due to AA artillery fire and SAMs, as well as some to other causes.

This period also witnessed 134 Iraqi aircraft flown out of the country to Iran. Speaking about this exodus General Schwarzkopf, C-in-C US Central Command said that this could be due to the following reasons.

1. That Iraq wanted to protect the aircraft for use at a future date.
2. That Iraq would use them for an attack from Iran, although Iranian leaders had said that they would not allow such an attack.
3. That the aircraft had been flown out by defectors.

The US and coalition pilots considered the Boeing E-3 AWACS as a key factor for success in air-to-air combat missions. "AWACS is all-seeing, all-knowing," one pilot said. "It gives us the 'big picture' and it can guide us right to the point of engagement." 41

The offensive strategy of the Coalition forces was to take advantage of the strength of the US Air Force in night attack and precision guidance capabilities to neutralise quickly Iraqi air defences with low level air strike missions. According to Aviation Week and Space Technology, "major advances in night and all-weather operations, precision navigation systems and weapons delivery, some of which were seen for the first time during US raids against Libya in 1986, are now undergoing their

41 ibid.
trial by fire in the air campaign against Iraq".  

The US pilots were able to fly to their targets with a high degree of precision by using Global Positioning Satellite System (GPS) and ring laser gyro-inertial navigation system. Over the target, the pilots used sophisticated targeting systems like the laser designator system on F-117s, the Martin Marietta Low-Altitude Navigation and Targeting Infrared for Night (Lantirn) system on F-15s, and Loral's Pave Tack system on F-IIIs. These systems enabled pilots to fire laser-guided or imaging infrared munitions with a very high degree of accuracy, just 1-2 ft CEP (circular error probability).

The US Air force used the new GBU-27 2,000-lb laser guided bombs with steel-encased penetration warhead, as well as GBU-24 laser-guided bombs fitted with BLU-109 1-2000 improved blast warhead, which is fitted with a delayed action fuze and penetrates deep before detonating.43


43 ibid.
The final phase of Desert Storm lasted just 100 hours and began with a massive air-ground assault which smashed the Iraqi Army and ended the Gulf War with a major tank battle near the Iraqi port city of Basra. Late on February 27, as the fighting near Basra ended, President Bush announced that "Kuwait is liberated", and "Iraq's Army is defeated, our objective is met". It was the Coalition air war which broke the back of Iraqi air and ground forces, and a half-million Iraqi Army was overcome in less than four days of fighting.44

Writing about the Coalition air campaign during the Gulf War, Mohamed Heikal said that the US Air Force was a dominating factor throughout the air campaign because of their numbers, fire power and advanced technology. It dropped about 6000 tons of precision guided munitions (PGM) including 'smart' bombs and guided missiles. The British Royal Air Force aircraft were intensively employed for attacking airfields at low level with high speed and single-pass to avoid damage from ground-based AA artillery and SAMs. "After a few days", says Heikal,''

the Iraqi Air Force largely withdrew from battle. The Coalition assumed that Iraqi pilots were demoralised, but in fact their withdrawal was ordered by the Revolutionary Command Council. Iraq was losing an average of seven or eight aircraft a day, a rate it could not sustain. 45

The total collapse of the Iraqi Air Force has been analysed and attributed to several reasons. Firstly, it is suggested that the Iraqis were at a very serious qualitative disadvantage due to their being unable to master the capabilities of their modern aircraft and suffered from weaknesses in training and morale of both pilots and technicians. Secondly, Iraq did not have the ability for coordination of all elements of the air force and integration of air defence operations. Lastly, the departure of 135 aircraft to Iran also suggested the intention of Iraq to save these from total destruction and keep them for use at a later stage.

"The failure of Iraqi Air Force was the result of weaknesses in training and lack of experience in operational planning and coordination. There had been little air combat during the Iran-Iraq War, and strike aircraft were used

45 Heikal, n. 30, p. 388.
in isolated raids from high altitudes. One expert summarised the air element of that war as a clear demonstration that, 'the most sophisticated and advanced aerial equipment is essentially useless if employed without a coherent strategic concept and competent operational plans and skills'.\textsuperscript{46} On D+10, when the Coalition forces claimed to have achieved total air supremacy, Iraq is reported to have executed its air force and air defence chiefs-of-staff, according to Soviet sources.'\textsuperscript{47}

Summary of Air Operations

During the 43-day Gulf War, Coalition air forces flew a grand total of 109,876 sorties and averaged about 2,550 sorties per day. A total of 27,000 sorties were flown against Scud launchers, airfields, air defence network, electrical power stations, biological and chemical weapon plants, command headquarters, intelligence centres, communications, the Iraqi ground forces and oil refineries. Flight refuelling tanker aircraft flew a total of 15,434 sorties or 60,000 hours of refuelling time and refueled 45,955 aircraft. US aircraft dropped 84,200 tons of


\textsuperscript{47} McCausland, n. 26, pp. 28-29.
munitions in 44,145 combat sorties; 67 per cent flown by the US Air Force, 19 per cent by Marine Corps, and 14 per cent by the Navy. Out of a total of 84,200 tons of munitions dropped, the US Air Force dropped 72 per cent, roughly 60,624 tons of both 'smart' and 'dumb' bombs, the Navy and the Marine Corps about 28 per cent. 7,400 tons of precision munitions, were dropped. The air force dropped 6,660 tons and the Navy and Marines 740 tons.\textsuperscript{48} The details of new technology air power used in the Gulf War 1991 is given at Appendix 'R'.

\textbf{Scuds Versus Patriots}

Iraq had Soviet supplied Scud B surface-to-surface tactical missile with a range of 200 miles. Some of these missiles, renamed as Al-Husayn and Al-Abbas, with increased ranges of about 400 miles were used during the Iraq-Iran War in the "battle of the cities". In the first and second phase of the Gulf air Campaign, most of the fixed Scud missile sites had been destroyed by the Coalition Air Forces. However, it was found difficult to locate the mobile missile launchers, but their search and destruction mission was continued

\textsuperscript{48} Hallion, n. 19, p.188.
throughout the war. In order to break the Coalition, Iraq mounted Scud attacks on Israel and Saudi Arabia. To counter the threat from the Scuds, the United States supplied Israel and Saudi Arabia with Patriot PAC-2 air defence missiles. While Scud had a velocity of Mach 8 or over 5,300 miles an hour, the Patriot's speed was mach 3. Iraq launched 93 Scuds of which 42 were fired at Israel, 48 at Saudi Arabia and 3 at Bahrain. In response, 158 Patriots were fired at 47 Scuds and according to initial assessment 45 Scuds were destroyed. The single one Scud hit of the War on Dhahran Barracks killed 28 and wounded 97 others.

The Coalition air forces flew 2,493 sorties to detect and destroy Scud launchers. Figure on the next page shows Scud versus Patriot SAM engagements.

Space-Based Systems

Space became the new frontier in warfare during the Gulf War of 1991. It was the first war fought by the United States which was comprehensively supported by space-based systems. Some of these systems which played a vital role are described below.

49 ibid, p. 178-185.
Scud ssm versus Patriot sam

1. Navstar Global Positioning System (GPS): It is based on 18 satellites in orbit 11,000 miles above the earth and provides accurate position information within 60 feet.

2. Defence Meteorological Support Programme (DMSP): This system played a vital role in mission planning by giving real-time weather above the theatre of operations.

3. Defence Satellite Communication System (DSCS): This provided a secure communications link in real-time with 100 terminals in the combat sector.

4. Low Altitude Navigation Targeting Infrared for Night (LANTIRN): This system provided pilots with the ability to mount low-altitude, high speed night attacks, in aircraft fitted with wide-field of view head-up-display (HUD), Navpod with terrain following radar, forward looking infrared system (FLIR) and Martin Marietta targeting pod with high resolution FLIR. The F-15Es used this system against Scuds, tanks and airfields.

5. Pave Low: This system enhanced special operations capability at night. The latest version Pave Low III MH-53J was fitted with machine guns, advanced ECM protection, digital avionics, and GPS receivers. It was originally designed to rescue downed airmen at night, but during the Gulf War it acted as pathfinder for US

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50 ibid, p. 313-315.
Army Apache gunships which were sent to attack Iraqi early warning radars in the first mission of the Gulf War.

General Assessment of Air War in the Gulf

President George Bush said, 'Gulf Lesson one is the value of air power.' The US Joint Chief of Staff, General Colin Powell said, 'Air power has been the decisive arm so far, and I expect it to be the decisive arm throughout the end of the campaign even if ground forces and amphibious forces are added to the equation. I expect air power to be even more decisive in the weeks and days ahead.' Henry Kissinger, former US Secretary of State, described air power as a means of coercive diplomacy. Air Force Chief of Staff General Michael Dugan had said before the Gulf War that the US air power could force Iraq out of Kuwait without a bloody land war. This is what actually happened, but the former US air chief was sacked by the US Secretary of Defence for expressing a unilateral opinion.

51 ibid, p. 241.
52 Heikal, n. 30, p. 392.
54 ibid, p. 316.
Section 3: Influence of air Power in the Gulf War of 1991

Analysis of Air Operations

The role of air power in the wars in West Asia had been progressively assuming greater predominance in shaping the strategies, tactics, and the nature of war in the region.

An analysis of the Gulf War air campaign shows that it achieved total success. The number of sorties flown by the Coalition air forces was 109,876. The total tonnage of bombs dropped was 88,500 tons, of which about 6,620 tons were precision guided weapons. The Coalition air forces shot down 35 aircraft of the Iraqi Air Force during aerial combat and also attacked and destroyed 375 hardened aircraft shelters out of the total of 594 built by Iraq for protection of its aircraft.55

It is reported that the F-117 stealth fighters in 1,300 sorties logged 6,900 hours of flying and dropped

2,000 tons of bombs over targets in Iraq. The number of sorties flown by F-15 fighters totalled 5,900. Additional 2,200 sorties were flown by F-15E fighter bombers in attacks against Scud missile launchers, tanks, airfields, and road communications. 8,100 sorties were flown by A-10 planes in the ground attack role. The number of sorties flown by the larger F-111 was close to 4,000 in which over 1,500 tanks were destroyed. The maximum number of missions flown by any aircraft during the air campaign was by F-16 and totalled 12,000. The B-52 bombers flew more than 1,600 sorties and dropped 26,000 tons of bombs. Aircraft from the carriers and the Marine Corps flew 17,000 missions on A-6s, AV-8Bs, and FA-18s.\(^5\)

The entire battlefield support was provide by JSTARS and AWACS air-borne warning and control aircraft, EF-111 Raven and EA-6B Prowler jamming aircraft, and a fleet of KC-10 and KC-135 in-flight refuelling tanker aircraft. A large number of air force, navy, and marine aircraft like the TR-Is and RF-4 for electronic intelligence collection were used to support the air campaign during the Gulf War. Even if the suggestion of General Merrill McPeak of the USAF, that for the first time in the

\(^5\) ibid, p. 124.
history of warfare, a field army was defeated by air power, may not be totally true, it is generally accepted that the air campaign created conditions for a fast and low-casualty ground campaign.\footnote{ibid.}

**Impact of New Technology Air Operations on Doctrine, Strategy, and Organisation**

One Senior Air Force Commander of the Tactical Air Warfare Center of the USAF, Maj General Gerald J. Carey, is reported to have said that, 'the eighteenth century was the era of land wars, the nineteenth of the sea. The twentieth was the era of air power, but war will be shaped in the twenty-first century by the electromagnetic combatants. The Air Force must be ready.'\footnote{Futrell, n. 2, p. 555.} The synergistic relationship between air power and electronic warfare, which is also known as the 'silent war' or 'war in the fourth dimension' has been amply demonstrated in the Wars of 1973, 1982 and 1991.

Doctrines for employment of air power, or land forces and sea power are designed within the general framework of 'principles of war' which have evolved over a period
of time based on experiences from many wars. These 'principles of war' are of an enduring nature and with slight changes have remained constant for almost two centuries. These are considered the most fundamental form of military doctrine and remain the basic guiding elements of warfare.\(^{59}\)

Some of the most important principles of war are as follows: selection and maintenance of aim; maintenance of morale; offensive action; concentration of force; economy of effort; security; surprise; flexibility; cooperation; and administration.

Air power, because of its inherent characteristics, of speed, reach, ubiquity, flexibility, responsiveness and concentration, greatly enhances certain principles of war like offensive action, concentration of force and firepower, economy of effort, surprise and flexibility. Speed, surprise and concentration of firepower make air power a very effective instrument of offensive strategy. According to Andrew Vallance, these characteristics 'are synergistic. Speed and mobility—when taken together—allow simultaneous

threats to be countered across a wide geographical area. Similarly, speed, mobility, and flexibility allow air power to concentrate military force in time and space against a specific target, to direct it against a variety of targets dispersed over a large geographical area, or to switch it between such tasks in response to the changing demands of the operational situation.' 60

The employment of air power during the wars in West Asia clearly demonstrates the exploitation of its characteristics within the larger framework of the principles of war. The Israeli Air Force, in 1967, while attacking and destroying a major portion of the Arab air forces employed the principles of offensive action, surprise, concentration of firepower, and flexibility. Similarly in the war of 1973 the flexibility of Israeli Air Force was used to switch within a few hours from the Suez front to the Golan front to counter the Syrian armoured assault. After the situation had stabilised, the Israeli Air Force was back in the Suez sector to support the Israeli crossing of the Canal and to counter the Egyptian counter attack on the small Israeli bridgehead on the west bank.

On the Arab side, the 1973 War proved the effectiveness of defensive counter air operations by surface-to-air guided missiles and anti-aircraft artillery. The Israeli Air Force lost 115-150 aircraft during the first few days of the campaign; and these losses would have crippled the Israeli Air Force if the United States had not mounted an emergency airlift of electronic counter measure systems and flown replacement fighter aircraft from NATO stocks to Israel. The SAM systems deployed by the Arabs demonstrated the principles of strategic and tactical surprise and concentration of firepower in time and space and thus enabled the Egyptian ground forces to cross the Canal and establish a bridgehead on the East Bank.

Since the principles of war are the most basic and fundamental form of doctrine, they must be examined frequently in the light of experience gained with the new weapon systems incorporating new technological and scientific developments. 61 In this context, new technologies, in the form of SAM systems, precision guided munitions, electronic warfare systems, RPVs, C³I, and satellite-based battle support systems have singled out air power as

the main beneficiary of new and advanced technologies thus giving it a predominant role as a war-winning factor and in fact changing the very nature of warfare.

Air power doctrine has been divided by the RAF Air Power Doctrine manual into three distinct categories. These are: Strategic doctrine, which lays down the strategic goals of air power; Operational doctrine which defines the various types of offensive and defensive operations and the roles to be planned and executed to achieve the strategic goals; and tactical doctrine which explains the methods to be followed for the integration of aircraft and airborne and ground-based support systems for a variety of missions to achieve operational goals.

RAF Air Power Doctrine defines air strategy as the overall employment plan for air force in a war. Because of its unique characteristics, air power has a wide range of strategic applications, (See following chart.) which essentially fall into three broad areas as follows.

1. Counter-air action. This is defined as the employment of air power to deter, contain, or defeat the enemy air forces. The strategic aim of counter-air operations is to gain the desired degree of command of the air.

2. Strategic Air Offensive. This involves use of air power in precision air attacks to destroy or damage enemy's war making capability. The strategic aim here is to weaken the ability of the enemy and his will to continue with the war.

3. Anti-Surface Force Operations. This encompasses the
employment of air power in cooperation with friendly land and sea forces to deter, contain, or defeat the enemy's army or the navy or both. The strategic aim of this operation is to prevent the enemy from occupying territory or exploit seaspace. (See chart below.)

The Air Campaigns

The air strategy for a specific war would be a combination of the above air operations, and the priorities for the various air campaigns would depend on each situation. The basic aim of air strategy would be to complement the military strategy formulated at the highest level to achieve political objectives of the war. Details of air campaign and various types of air operations are shown in the chart on the next page.

During the 1973 War, Egypt's limited military objective
Air Strategy

**AIR STRATEGY**

<table>
<thead>
<tr>
<th>STRATEGIC AIR CAMPAIGNS</th>
<th>ANTI SURFACE FORCE</th>
<th>COUNTER AIR</th>
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<tbody>
<tr>
<td>NUCLEAR OPERATIONS</td>
<td>CONVENTIONAL OPERATIONS</td>
<td>AC WEAPONS SYSTEMS &amp; TACTICS</td>
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<td>MARITIME AIR OPERATION</td>
<td>AC WEAPONS SYSTEMS &amp; TACTICS</td>
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<td>AC WEAPONS SYSTEMS &amp; TACTICS</td>
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<tr>
<td>OCA OPERATION</td>
<td>DCA OPERATION</td>
<td>AC WEAPONS SYSTEMS &amp; TACTICS</td>
</tr>
<tr>
<td>AIRFIELD FIGHTER</td>
<td>SEAD</td>
<td>AC WEAPONS SYSTEMS &amp; TACTICS</td>
</tr>
<tr>
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<td>AIR TO AIR SURFACE TO AIR</td>
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</tr>
<tr>
<td>AC WEAPONS SYSTEMS &amp; TACTICS</td>
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**NOTE:**

AI: Air Interception; OS: Offensive Support; CAS: Close Air Support; BAI: Battlefield Air Interdiction; SEAD: Suppression of Enemy Air Defence; ASW: Anti-Submarine Operations; AVSW: Anti Surface Warfare; Mi: Maritime Interception; OCA: Offensive Counter Air; DCA: Defensive Counter Air; AC: Aircraft.

was to cross the Canal and establish and consolidate a bridgehead on the East Bank. The air power strategy to achieve this goal was to counter the superior Israeli Air Force, which alone was capable of interfering with the Egyptian assault across the Canal, by counter-air operations by ground-based air defence weapon systems comprising new technology surface-to-air guided missiles and anti-aircraft artillery. By adopting this strategy Egypt was able to achieve its limited aim and crossed the Canal successfully at the same time inflicting very high casualties on the Israeli Air Force which lost more than 100 aircraft during the first three days.\textsuperscript{63} It was the first case in the brief history of air power when air supremacy was achieved by ground-based air defence weapon systems.

The effectiveness of SAM systems against aircraft, as witnessed in the 1973 war, made "defence suppression" one of the major roles for achieving command of the air with new technology electronic counter measure systems. Anti-radiation missiles along with electronic battlefield surveillance by aircraft and RPVs provided important support

\textsuperscript{63} Futrell, n.2, p. 485.
missions as witnessed later in the 1982 war in the Lebanon.

The Israeli strategy during the 1973 War had to take into account the element of surprise and the fact that the Israeli ground forces were retreating on both fronts under pressure from Arab ground forces and it needed time to mobilise its reserves. During this period of mobilisation Israel used its air force for anti-surface operations to stem the tide of advance first on the Syrian front and then on the Egyptian front. The flexibility of the Israeli Air Force was clearly demonstrated during the switch over of forces from one front to the other. Another important lesson was the unity of command of the Israeli Air Force which enabled Israel to deploy its entire air assets in the sector most threatened without delay. This needed an efficient command, control, communications, and intelligence (C3I) system which could only be possible with new technology electronics.

It would, therefore be evident that the air strategy followed by the Israeli Air Force in the two wars of 1967 and 1973 was entirely different. While in 1967, Israel had used the major portion of its air force for counter-air operations during the first few days, in 1973
it had to use its aircraft for anti-surface force operations. In the Gulf War of 1991 the strategy of air operations was rather complex and these operations were planned and executed in four phases. During phase one, the Coalition air power was to achieve command of the air in the first seven days, as also attack strategic targets inside Iraq. The suppression of Iraqi ground to air defences in Kuwait was to be done during phase two, while phase three required attacks against the Iraqi Army in Kuwait. In the final and fourth phase, the air forces were to cooperate directly with the Coalition armies advancing into Kuwait and southern Iraq. During the war the four phases tended to merge and at times were conducted simultaneously.64

After the experience of 1967 War, Israel evolved a doctrine of joint operations between the army and the air force. It was the task of the air force to obtain command of the air first and then to support the ground forces in their battles with the Arab armies.65

In the beginning of the 1982 conflict, Israel's air

65 Cordesman and Wagner, n. 10, p. 214.
strategy was to support ground forces during their assault into Lebanon. To counter the Israeli air threat, particularly in the Bekaa Valley, the Syrians moved their missile sites into the Valley and with these latest missile systems they hoped to shoot down Israeli aircraft flying over Lebanon. However, the Israelis had learnt their lessons well during the 1973 War and they had evolved an integrated tactical plan of missile defence suppression using electronic warfare equipment, RPVs, and E-2C Hawkeye airborne warning and control aircraft for C³I duties. With their integrated plan and new tactics evolved for exploitation of new technology weapons, the Israelis attacked and destroyed 19 missile sites and over 80 aircraft of the Syrian Air Force with only a few losses to themselves.66

A report on the lessons of the Gulf War of 1991 by the House Armed Services Committee of the US Congress stated that the decisive factor in the war was the air campaign, but ground forces were necessary to eject the Iraqis from Kuwait. It also stated that the effective use of high technology was a key reason for the high level of performance of air and ground forces, and the

66 Futrell, n. 2, p. 556.
minimisation of allied casualties.\textsuperscript{67} (Summary of the report is at Appendix 'S')

It is interesting to compare the casualties suffered by the US Army in the Gulf War with those of the previous wars. In the Gulf War there was hardly any direct combat between the American troops and Iraqi ground forces. The weapon system used was always an aircraft, a helicopter or a missile. Therefore, most of the American troops had no occasion to use their personal weapons. The table below gives a comparative analysis of American casualties during various wars in recent history:\textsuperscript{68}

<table>
<thead>
<tr>
<th>Strength</th>
<th>Casualties</th>
<th>Casualties/Day as % of theatre strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil War</td>
<td>400,000</td>
<td>387,200</td>
</tr>
<tr>
<td>Spanish Civil War</td>
<td>50,000</td>
<td>1,872</td>
</tr>
<tr>
<td>World War I</td>
<td>990,000</td>
<td>261,657</td>
</tr>
</tbody>
</table>


\textsuperscript{68} Hallion, n. 19, p. 238.
The new technology air power with precision guided munitions, electronic warfare systems and C3I support systems has acquired the ability to attack the enemy's 'Centre of gravity' with accuracy and discrimination. The fundamental doctrine of air power, postulated by Douhet, of "command of the air" has become totally capable of achievement with new technology weapons. The lessons of 1973, 1982, 1991, have proved beyond any doubt the importance of realtime intelligence in shaping air strategy for the conduct of air operations. "Defence suppression" has become an important task for air power and needs new technology electronic warfare systems and anti-radiation air-to-surface missiles.

The new technology weapons have enhanced both the defensive and offensive capabilities of air power. However, it is only by an offensive strategy that air power can be a war-winning factor. This is because of its inherent characteristics of surprise, mobility, flexibility and concentration of firepower. The strategy followed in a
particular campaign, as regards the priority and effort allotted to various roles of air power, i.e., counter-air operations, air operations against strategic targets and anti-surface force air operations, would depend on the specific conditions of a particular situation, as clearly demonstrated in the series of wars considered in the previous pages. (see Chart below).

The new technology weapon systems have given a new dimension to defensive counter-air operations as evident from the success of the Egyptian missile umbrella over the Suez Canal and the Syrian missile sites in the Bekaa Valley. The aim of defensive counter-air operations is to minimise the damage to friendly forces and to inflict maximum attrition on the enemy.69 The structural framework of defensive counter-air operations is given in Chart

69 Air Power Doctrine, n. 74, p. 48.
below. While Egypt was totally successful in its defensive strategy for gaining its limited objective of crossing the Canal, the Syrian SAM systems were effectively countered by Israel by developing an integrated 'defence suppression' strategy which involved the use of aircraft, RPVs, electronic counter measure equipment, and C³I systems.

![Diagram of Defensive Counter-Air Operational Structure]

A recent study conducted by RAND of the United States indicates that the calculus of force utility has changed,
and airpower's ability to contribute to the joint battle has increased. "Not only can modern airpower (with new technologies) arrive quickly where needed, it has become far more lethal in conventional operations. Equipped with advanced munitions either in service or about to become operational and directed by modern C³I systems, air power has the potential to destroy enemy ground forces simultaneously destroying vital elements of enemy's war fighting infrastructure." ⁷⁰

Apparently deriving its conclusions from the Gulf War of 1991, the RAND study says that in the initial stages of the war, naval forces provide an enduring presence, and as the United States moved into the conflict, the relative contribution of naval forces reduced. Land-based air power, however, now emerges as the dominant element in the critical stages of the war. On the other hand, ground forces build up slowly, but are considered necessary for evicting the aggressor from the occupied territory. ⁷¹

⁷⁰ Christopher Bowie, , The New Calculus : Analysing Airpower's Changing Role in Joint Theatre Campaigns (Santa Monica, RAND, 1993), pp. 82-84.
⁷¹ ibid.
It must be emphasised that while new technology is of vital importance as a battle-winning factor, the credit for winning a war always goes to the side which has formulated an appropriate operational doctrine to exploit effectively the new technology weapon systems in an integrated and holistic framework of strategy. The lack of a joint strategy on the side of Egypt and Syria during the 1973 War was evident from the ad-hoc decisions to counter the Israeli counter-attack during the later phases of the war.

Air Power has always been at the sharp leading edge of new technology. Recent technological developments like, PGMs, EW, Stealth, satellite-based systems have engendered a quantum jump in the performance of air power, thereby changing the very nature of warfare which has become dominated by air operations. New technology has enabled aircraft to fly by day or night and in all weather, navigate accurately to the target and deliver weapons within a few feet from the aiming point. Its ability to attack the "nerve centres" of the enemy provides a quick means of destroying the command and control structure thus making it difficult if not impossible to continue the war.
The air effort needed and the CEP (Circular Error Probable) - which is an imaginary circle with an area large enough so that 50 per cent of the bombs dropped fall within it - is given in the following table for weapons used since WWII to destroy a target of 60 x 100 ft.\textsuperscript{72}

<table>
<thead>
<tr>
<th>War</th>
<th>No of Bombs</th>
<th>No of Aircraft</th>
<th>CEP ft</th>
<th>Type of Bombs</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWII</td>
<td>9,070</td>
<td>3,024</td>
<td>3,300</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>Fall 1990</td>
<td>30</td>
<td>8</td>
<td>200</td>
<td>2,000 lb</td>
</tr>
<tr>
<td>1991 War</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>'Smart'</td>
</tr>
</tbody>
</table>

The nature of warfare has undergone a revolutionary change with the synergistic interaction of air power and electronic warfare systems. Wars in the 'third' and 'fourth' dimensions have merged to transform the modern battlefield. The speed and outcome of aerospace operations require closer command and control at the highest level of military and political leadership. To achieve success in such operations by closely integrating grand strategy, military strategy, and operational strategy, it is essential to have interaction at the very top level of political and military leadership. Similarly, at the apex of military hierarchy, total integration and interaction would be

\textsuperscript{72} Hallion, n. 19, pp. 282-283.
necessary to fully exploit the characteristics of new technology weapons. At the operational level, integration of all plans according to military strategy has to be ensured by appointing a single theatre commander who will be responsible for all operations in the theatre.

As far as air operations are concerned, these must be under the command of a single commander in the theatre who will be responsible to the theatre commander. It is vital to have all air assets, whether of the air force, army or the navy, to be tasked by a single authority, so that the inherent characteristics of air power, like, flexibility, surprise, and concentration of firepower in time and space can be fully exploited.

Finally, military forces would need restructuring. In this era of emerging new technologies, it is vital to maintain a qualitative edge in military capability through selective modernization. The enhancement of military capabilities due to mobility forces, PGMs, advanced fighter aircraft, and C³I systems would need much higher defence spending. In this situation, it may be necessary to "trade" quantity for quality by selective modernization of military forces.\textsuperscript{73} The role of aircraft carrier in

\textsuperscript{73} Bowie, n. 70, pp. 82-84.
this context needs to be reviewed. It has proved extremely expensive per ton of bombs dropped and can be sunk. Its extreme vulnerability necessitates diversion of considerable naval forces for its protection. The role of tanks against armed helicopters also requires review. "The helicopter may indeed have done for the tank what the bomb-carrying aircraft did for the battleship. The mobile, three dimensional weapon may have got the edge over the lumbering object below.'"\(^\text{74}\)

The "Blitzkrieg" of the future battlefield may not be the mass of armour supported by large formations of aircraft. It could well be formations of stealth fighter bombers supported by aircraft-mounted and space-based electronic warfare systems. To clearly understand all the implications of new technology weapons in war-fighting, would require moving away from the "narrow traditionalism and earth-bound quality of the solider.'"\(^\text{75}\) According to Will and Ariel Durant, "Coastal cities will derive less of their wealth from the clumsy business of transferring


goods from ships to trains or from trains to ships. When sea power finally gives place to air power in transport and war, we shall have seen one of the basic revolutions in history. This revolution began sometime ago. The lessons of the impact of modern air power in the outcome of recent wars need to be carefully noted and absorbed so that appropriate doctrines, strategies and organisations, are created for exploiting new military technologies. The main issue that emerges is not only high technology weapons, which have proved their worth in capable hands, but what is more important is the ability to use them.

After this detailed analysis of the impact of new technologies on air power, it would not be out of place to pursue some lesson from the perspective of Indian security.

Section 4: Modern Air Power in the Indian Context

New Technology Arms Race in South Asia

Since independence in 1947, there have been several wars on the Indian sub-continent. The dawn of independence saw the J&K operations of 1947-48. The Sino-Indian conflict

of 1962 ended the friendly relations between India and China which remained in cold storage for almost two decades and have only recently shown some signs of revival. The Wars of 1965 and 1971 with Pakistan kept the hostile postures alive thus resulting in an arms race in the sub-continent, actively supported by the two erstwhile superpowers and other Western arms producing countries. After the Chinese nuclear explosion in 1964 and subsequent build up of Chinese nuclear capability, India also exploded a peaceful nuclear device in 1974. Pakistan had been following the path of nuclear weapons programme and it is now reported to have acquired the capability to produce nuclear weapons.

Some of the details of the arms race between India Pakistan and China relevant to air power are given below. 77

<table>
<thead>
<tr>
<th>Indian Inventory : Delivery Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirage 2000 fighter ground attack</td>
</tr>
<tr>
<td>MiG-29 fighter ground attack</td>
</tr>
<tr>
<td>MiG-23 fighter ground attack</td>
</tr>
<tr>
<td>MiG-27 fighter ground attack</td>
</tr>
</tbody>
</table>

India's Missile Programme

'Prithvi' surface-to-surface missile has a range of 150-250 Km and a warhead of 500-1000 kg. It is under user trials. 'Agni' is a technology demonstrator with a range of more than 2000km.78

Pakistan Inventory : Delivery System

F-16 fighter ground attack 35
Mirage III EP fighter ground attack 18
Mirage 5 PA3 fighter ground attack 58

Pakistan's Missile Programme

Pakistan is reported to have developed Hatf-1 and Hatf-2 surface-to-surface missiles.79 Hatf-1 is a single-stage ballistic missile with a weight of 500kg and a range of 80km. Hatf-2 is a two-stage ballistic missile with a weight of 3,000kg and a range of 280km. In addition, it is believed that Pakistan has some M-11 missiles supplied by China with a range of 200km and a warhead of 800kg.80

Chinese Inventory

<table>
<thead>
<tr>
<th>Delivery Systems</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-6</td>
<td>Medium bombers</td>
</tr>
<tr>
<td>H-5</td>
<td>Light bombers</td>
</tr>
<tr>
<td>Q-5</td>
<td>Fighter ground Attack</td>
</tr>
<tr>
<td>J-5</td>
<td>Fighters</td>
</tr>
<tr>
<td>J-6</td>
<td>Fighters</td>
</tr>
<tr>
<td>J-7</td>
<td>Fighters</td>
</tr>
<tr>
<td>J-8</td>
<td>Fighters</td>
</tr>
<tr>
<td>SU-27</td>
<td>Fighters</td>
</tr>
<tr>
<td>SU-27B</td>
<td>Fighter trainers</td>
</tr>
</tbody>
</table>

Strategic Missiles

| ICBM | CSS-4 and CSS-3 | 14 |
| IRBM | CSS-2           | 90 |

Tactical Missiles

| M-9 | Range 500km | ? |
| M-11 | Range 150-200km | ? |

Import of New Technology Weapons Versus Indigenous Production

From the details given above, it would be evident that the major element of air power weapon systems in

81
The Military Balance, n. 79, p. 152.
India and Pakistan have been obtained from the United States or the erstwhile Soviet Union. Replacement of aircraft losses and replenishment of weapons consumed at a phenomenal rate during modern wars from external sources is at best very doubtful as was experienced during the 1965 and 1971 Indo-Pakistan Wars. The vital necessity for indigenous production of defence equipment has been clearly realised in India and Pakistan and both countries have made positive efforts to establish defence industries in collaboration with foreign producers.

India has so far, perhaps, been ahead of Pakistan in the field of producing aircraft and missiles under license and collaboration with the former Soviet Union. India's expenditure in defence research and development has shown a positive increase during the last 10 years. From a modest figure of Rs 76 crores in 1980, it increased to Rs 952 crores in 1993.\textsuperscript{82} (See Chart) In percentage terms expenditure on defence R&D increased from 2.05 in 1980-81 to 4.96 in 1993-94. This would provide more funds for major projects like the Light Combat Aircraft (LCA), Arjun main battle Tank (MBT) and for the integrated missile development programme (IMDP).

\textsuperscript{82} Jasjit Singh (ed), \textit{Asian Strategic Review 1992-93} (New Delhi, 1993), pp. 53, 56.
Indian Air Force Modernisation Programme

India acquired a squadron of MiG-29 fighter aircraft in 1988-89. These were state-of-the-art-fighters fitted with larger pulse doppler look down shoot down radars, giving them all-weather and day and night capability against low-flying enemy aircraft.83

India added numbers of MiG-29, MiG-27, and Mirage-2000 aircraft to its inventory during 1990-91. Additional Mi-25 and Mi-35 helicopters were acquired, and air-lift capability was enhanced by induction of AN-32 transport

83 ibid, p. 92.
aircraft from the former Soviet Union.\textsuperscript{84} Air Force modernisation programme also included induction of indigenously produced missiles, and the update of avionics, radar and communications systems. The disintegration of the Soviet Union disrupted defence supplies to India. President Yeltsin's visit to India in 1993 and exchange of high level defence delegations of Indian and Russian military officials have led to resumption of defence supplies. There has been a proposal to produce spare parts for the MiG-21 aircraft in collaboration with Russia. This would meet the spares need of the air force for MiG-21 aircraft. There is also a proposal to upgrade the MiG-21 fleet of about 400 aircraft pending the induction of the LCA which is reported to be behind schedule. Despite a substantial effort at indigenous production, and manufacture of Indian designed HF-24 fighter bomber "Marut'', and the Gnat, as well as trainer aircraft like the HT-2, HJT-16 "Kiran'' and HPT-32, the aircraft industry has not been able to produce an advanced jet trainer for the Indian Air Force. Consequently, the need has arisen to import about 150 advanced jet trainers to meet the training requirements of the Indian Air Force.\textsuperscript{85}

\textsuperscript{84} ibid, p. 95.
\textsuperscript{85} ibid, p. 98.
Light Combat Aircraft for the IAF

According to the Ministry of Defence Annual Report of 1993-94, the light combat aircraft (LCA) project has reached a stage where hardware fabrication and integration can be undertaken. Fabrication of major components of the fuselage and their assembly is in progress. There is satisfactory progress on the fabrication work on the carbon-fibre wing. "Version V-2 of control law has been formulated and validated on a real time simulator. Qualification testing of the indigenously developed mission computer hardware has been completed. Design reviews of cockpit display items have been fabricated, and the assembly of aircraft-mounted auxiliary gear box is nearing completion. Test rigs for brake management system, environmental control system, and dynamic avionics integration etc, have been commissioned. Activities are being geared to meet roll out of the first Technology Demonstrator LCA platform in June 1995." 86

There has been a number of criticism of the LCA programme. Speaking at a USI organised Seminar former Deputy Chief of the Air staff, Air Marshal KD Chadha, the top most officer dealing with induction of new aircraft

86 Ministry of Defence Annual Report, n. 78, p. 34.
in the IAF, said that by the time the LCA is inducted the only indigenous item in the system would be the Indian pilot.  

Maj General Partap Narain in his recent book, considers the expenditure of 10,000 crores on the LCA project as sheer waste of resources. Since the specifications of the LCA were written several years ago, the aircraft is unlikely to meet out requirements in the next century when it is going to be introduced in the service in numbers, due to changes in technology and doctrines. Critics of the LCA contend that the end result will not be light or cheap, with more than 70 per cent of imported components.

Arun Singh Committee

In 1990, a Committee on defence expenditure was appointed under the former Minister of State for Defence, Mr Arun Singh to advise on rationalisation and modernisation of the armed forces. It submitted its report in 1991 but it has not been made public. However, the

87

88
Partap Narain, (Maj Gen), Indian Arms Bazaar (New Delhi, 1994), pp. 164, 296, 297.
recommendations of the Committee are fairly well known, and it is reported that the main thrust of the report was that priority should be given to modernisation which should be financed by limiting manpower and if necessary cutting on numbers. The lessons of the Gulf War in 1991 made the recommendations of Arun Singh Committee even more acceptable. "The shattering defeat inflicted by the Multi-National Forces on the larger Iraqi army, which like the Indian Army relied heavily on Soviet equipment caused concern in New Delhi." 89

It was generally felt that it would not be right to ignore the advantages of new technologies and maintain a large number of forces with large quantities of obsolete equipment. Soon after the war, the then Minister of State for Defence, Raja Ramanna supported the approach adopted by the Arun Singh Committee and confirmed that it would be necessary to trade off expenditure on manpower for the needs of modernisation. It now appears that the recommendations of the Committee about modernisation have been shelved due to shortage of funds. 90

90 ibid.
The defence budget has provided reduced allotments in real terms during the past several years. This has prevented any modernisation measures in the air force and also reduced effective number of squadrons from 40 to 35. Flying effort has been reduced to conserve fuel. In view of economic constraints, perhaps the best results in modernisation could be achieved by introducing 'force-multipliers' like improvement in electronic warfare systems, command, control, communications, an intelligence (C3I), and logistics capabilities. Even limited improvements in these areas of operations with the help of new technologies and doctrines, as in the case of the Gulf War, would be of immense benefit to the Indian armed forces. The Kickleighter proposals which involve regular visits by the Indian and American senior commanders, regular staff discussions, and exchange of information as well as combined training exercises could enable Indian armed forces to obtain some information about some of the doctrines and technologies employed by the US forces in the Gulf War. However, such mutual consultations are, for the time being, on a very low key, because of political constraints. In any case, the United States is unlikely to transfer information about the state-of-the-art technologies and doctrines to India, though it has agreed to the transfer of US $ 400 million of older electronic warfare equipment
which included payment for IBM 3090 design computer for use on the light combat aircraft. According to Sandy Gordon, "one of the greatest impediments to the development of a more effective system of C^3^I is the lack of organisational integration in the command structures of the Indian armed forces."\(^9^1\)

In the field of C^3^I, it is reported that the army's communication system has been modernised. It is proposed to link forward radar stations already in place through satellite communication, fibre optics, and microwave systems. Some reports indicate that India is already capable of surveillance by improved satellite (IRS) to a resolution of 30 feet which is suitable for military purposes.\(^9^2\) This could provide India with a full-fledged real-time capability in the field of C^3^I. Former Defence minister Sharad Pawar and other Indian leaders have confirmed their commitment to military modernisation programme despite economic constraints.

The Indian indigenous production programme for selected weapons has been as follows: Jet aircraft, 1963; propellor

\(^9^1\) ibid, p. 948.
\(^9^2\) ibid, p. 949.
driven aircraft 1953; armed helicopters, 1993; guided missiles, 1993; main battle tank, 1995; large calibre artillery, 1980; radar, 1988; and major warships, 1978. Some of these programmes like the Advanced Light Helicopter (ALH), the Akash, Nag, Prithvi, and Trishul guided missiles and the Arjun main battle tank are all fairly close to but not in full scale production. Most of these programmes are reported to be experiencing major cost and time overruns. In the 1980s, India negotiated government-to-government agreements to obtain new technologies from European countries and from the United States for its indigenous weapon production programmes.93 Estimated values of the trade in licensed production, and indigenous production of major weapons, 1965-90 in US $ (1990) million is given in the chart on the next page.94 The chart shows the growth of indigenous production from US $ 133 million in 1965 to US $ 1,198 million in 1990. Licensed production during the same period increased from US $ 60 million to US $ 1,078 million. Direct imports of major weapons during 1965 and 1989 rose from US $ 580 million to US $ 3,495 million but decreasing sharply to

94 ibid, pp. 370-371.
ESTIMATED VALUE OF THE TRADE IN INDIGENOUS PRODUCTION, LICENCED PRODUCTION AND IMPORTS OF MAJOR WEAPONS IN INDIA 1965 - 1990

(IN US $ (1990) MILLION)

A --------- INDIGENOUS PRODUCTION
B --- X--- LICENCED PRODUCTION
C --- II--- IMPORTS
D --- ----- TOTAL

US DOLLAR (1990) MILLION

SCALE
VS 2.5cm =1000
HS 1cm =1 YEAR

SOURCE: HERBERT WULF (ed) ARMS INDUSTRY LIMITED (OXFORD UNIVERSITY PRESS FOR SIFRI 1993) PP 370 - 371
US $594 million in 1990. This sharp decrease in imports was, perhaps, as a result of the dissolution of the Soviet Union, India's main supplier of military hardware, and due to financial crunch.

Progress in Indigenous Production

In a progress report released in April 1992, the Defence Research and Development Organisation (DRDO) confirms the need for modern high-tech warfare, and technological superiority of weapon system as the competitive and winning edge in war. The report states that the scientists and engineers of DRDO are dedicatedly working to provide this decisive and winning edge to the Defence Forces.95

One of the major efforts of the DRDO is in the field of missile technology. The Integrated Guided Missile Development Programme (IGMDP) has undertaken the development of four missiles; Prithvi, Trishul, Akash, and Nag. Prithvi is a surface-to-surface missile which can carry a warhead of one ton up to a range of 150 Km. It is considered to be very suitable for conventional warheads as it has a low CEP. Trishul, a short range, surface-to-air missile has an all-weather and quick reaction capability. According

95 Growth and Achievements of DRDO in Last Ten Years (New Delhi, Ministry of Defence, DRDO, 1992), p. 2.
to the DRDO report, Prithvi And Trishul were to be produced and inducted into service after user trials in early 1993. However, the Ministry of Defence Annual Report 1993-94 states that both missiles are still under evaluation by the DRDO and getting ready for user trials. Akash, another surface-to-air missile with a range of 25 Km, is scheduled to enter service after user trials in 1995. The anti-tank missile Nag with a range of four kilometers is undergoing evaluation trials by the DRDO and so is Akash which was successfully launched from Interim Test Range (ITR) Balasore on February 3, 1994.96

The DRDO report also talks about the re-entry technology demonstrator Agni which has been under development since its first flight in 1989. With a range of more than 2,000 km, it is considered to be in the Intermediate Range Ballistic Missile (IRBM) class. About the future development programme of Agni, the Prime Minister Narasimha Rao informed Parliament on May 3, 1994 that the first phase of the experiment had been completed but that this did not mean that the programme was being shelved. There is no capping of the missile programme at this stage. He confirmed that the experiment will be

96 Ministry of Defence Annual Report, n. 78, pp. 36-37.
taken up in all its phases. 97

Another prestigious programme undertaken by the DRDO is the Main Battle Tank (MBT) Arjun, which, according to the DRDO report, incorporates the world's latest technologies in tank design and it would be comparable to any of the contemporary tanks in the world. "Its main features are its superior firepower, high battlefield mobility, excellent armour protection, day and night fighting capability, fire-on-the move capability, high first round hit probability and highly accurate weapon ammunition system." 98 The latest Ministry of Defence Annual Report states that "the indigenous main battle tank (MBT) Arjun, after successful trials, was accepted by the Army. Six pre-production series tanks were handed over to the Army for confirmatory trials. Evaluation of these tanks is under progress. Nine more pre-production tanks are under manufacture. Preliminary planning for its productionisation has been initiated by the Department of Defence Production and Supplies." 99

97 The Times of India (New Delhi) May 4, 1994, p. I.
98 DRDO Report, n. 95, p. II.
99 Ministry of Defence Annual Report, n. 78, p. 35.
The most important indigenous programme, particularly in the context of modernisation of the air force is the Light Combat Aircraft (LCA) project. According to the DRDO report the LCA is smaller and lighter than any other contemporary combat aircraft. "It incorporates state-of-the-art technologies and modern design concepts such as relaxed static stability, fly-by-wire control system, advanced avionics, high strength composite material, and multi-mode radar. Short take off and landing and a wide range of weapon-fit are some of its salient features." The report indicated that the first flight of the LCA is scheduled for 1996-97 and the aircraft is expected to be inducted into service in the early years of the next century. The LCA prototypes will have General Electric's F-404 engines. Simultaneously, a development programme for the GTX-35 VS 'KAVERI' engine to power the LCA is in progress. This is an advanced technology 80 KN thrust class engine which is an improvement on F-404. The latest report of Ministry of Defence states that the Kaveri engine for the LCA has entered the fabrication stage.

100 DRDO Report, n. 95, p. 12.
101 Ministry of Defence Annual Report, n. 78, p. 34.
Speaking in Parliament, Minister of State for Defence Mallikarjun told the members on May 3, 1994, that progress in the manufacture of the Light Combat Aircrat (LCA) had been very good and its prototype would be ready in 1996. He further stated that the production of the aircraft would start in the year 2003. Further the Minister gave details of major research and development programmes for the defence forces and said that these were aimed at reducing the country's dependence on imports. He claimed that India would be in a position to reduce its dependence on imports from the present 70 per cent to 30 per cent by the year 2005. The minister told Parliament that an agreement had been signed with Russia for upgrading the MiG-21 fleet. The aim was to make these aging aircraft into the state-of-art jet fighters which could give reliable service till the end of this century. Mr Mallikarjun also said that India was in the process of negotiating with other countries for acquiring sophisticated radars, weapon delivery systems, avionics and other sub-systems. Another important subject covered by the Minister was the purchase of advanced jet trainers for the air force. He said that after considering various types of trainers,

102

two of them had been shortlisted. These were the British Hawk and the French Alpha Jet and the process of final selection had begun.\(^{103}\)

**Planning for Indigenous Development and Production**

There is a view that the three services and the DRDO are not working to an integrated and joint plan for development and production of military hardware to meet the needs of a twenty-first century battlefield. Each service tends to look to its own requirements in isolation without fully realising that in future wars all defence services will have to fight a joint campaign. This has been the most important lesson since the Second World War, and has been adequately proved in the recent Gulf War. Therefore, the first requirement is to develop a joint doctrine for fighting a war in the Indian context and then work out the requirements of weapon systems for each service which would enable it to perform its task effectively in its environment, in a synergistic relationship with the other two services. The need for a joint and integrated doctrine for war-fighting in the Indian context has become a vital factor because of the

\(^{103}\) The Times of India, (New Delhi) May 4, 1994, p. 4.
change in the very nature of war due to new technology weapons and support systems. Only a joint and integrated plan for indigenous production of new technology weapons would ensure that the limited resources are being employed to achieve maximum cost-benefit ratio.

This can be done if there is an institutionalised mechanism for evolving joint doctrines, plans and strategies for war fighting and appropriate listing of weapons and their priorities for indigenous production. A Chief of Defence Staff (CDS) who is the fourth member of the top team with his own staff from the three services-joint staff—could effectively deliver the goods. He will be responsible for all joint planning and programming and will be the senior defence adviser to the Prime Minister and the Defence Minister. The command and control of each service in peace and war would continue to remain with the head of the service who would have direct access to the Prime Minister and the Defence Minister. Similarly, a "grand strategy" should be evolved by effectively integrating political, economic, diplomatic, and military factors in a total and holistic framework of national security. India urgently needs an institutional mechanism at the top political and military level. Recent announcement in Parliament by the Prime Minister Narasimha Rao, regarding
the intention of the government to set up a National Security Council is a step in the right direction.\textsuperscript{104}

Finally, there is an urgent need for closer interaction between the users of the weapons and the producers in order to effectively meet the user requirements. The Indian Air Force had indicated the need for an advanced jet trainer aircraft atleast ten years ago. But there seems to have been a lack of response for this project from the DRDO, with the result that today the air force is forced to import the trainer—which is not a high technology system and could have been easily manufactured in India—at a cost of more than Rs 5,000 crores. If we are not able to build a low technology system like the advanced jet trainer, how are we going to manage the production of the LCA designed to meet the technological threats of the twenty-first century?

In this context, one could suggest the appointment of a Presidential Commission to recommend rationalisation and streamlining of the Defence Research, Development, and Production facilities and its bureaucratic structure.

\textsuperscript{104} ibid, p. 1.
By strengthening Defence Research and Development Organisation in the country, not only the defence forces would benefit, but there will be spin-offs for the civilian sector as well. Most of the new technologies are dual-use technologies with applications in the civil sector. During the period 1982-1991, 26 important technologies were transferred to the civil sector. This is particularly applicable in the field of electronics and space-based systems. The satellite-based support facilities for the Gulf War and the simultaneous spread of 'Star TV' across the globe are good examples of dual use technologies.

Options for India

In the wake of the news that the United States is likely to transfer 38 F-16 Falcon fighters to Pakistan by making a one time exception to Pressler Amendment, the Standing Committee on Defence of the Indian Parliament has strongly recommended to the Government that the strike and interdiction capabilities of the Indian Air Force should be urgently upgraded to meet the threat from Pakistan. The committee in its second report released in April 1994 expressed its serious concern over Pakistan's acquisition of additional F-16 strike fighters.105

105 "Upgrade IAF to meet Pak Threat: Panel" The Economic Times (New Delhi), April 23, 1994, p. 5.
``It is a matter of all the more concern, considering the deficiencies which affect the operational efficiency of the IAF strike fleet due to problems of spares.''

The Committee has strongly supported the immediate clearance by the Government of major IAF projects like the upgrading of the MiG-21 fleet and the proposal for the purchase of advanced jet trainer aircraft. It has also recommended acquisition of additional strike aircraft to meet the emerging threat from Pakistan and recommended adequate measures to improve the aircraft capabilities by superior avionics, and weapon systems. The Parliamentary Committee noted that in modern warfare, the electronic warfare systems, electronic counter measures and counter-counter measures (ECM and ECCM), air-borne warning and control systems (AWACS) and similar ``force multipliers'' played a crucial role as demonstrated in the recent war in the Gulf, and these could prove to be the deciding factor in any war in this region also. The Committee recommended more modern equipment for the army to achieve the long-term objective of a `leaner and meaner Army'.''

New Technology and High Cost

The report of the Parliamentary Standing Committee

106

ibid.
on Defence highlights the role of new technology systems as a war-winning factor and seems to have drawn on the lessons of the Gulf War of 1991. However, the cost of new technology systems in large numbers is beyond the means of developing Third World countries whose resources are so limited that they are not able to support even low technology systems in reliable condition. The cost of a Second World War fighter like the Hurricane or Spitfire was about £100,000, but Tornado F3 at present costs £15 million and the expected cost of the Eurofighter 2000 is going to be close to £20 million. The US stealth fighter F-22 is going to cost $148.8 million and the B-2 bomber $830 million. At these escalating costs it is expected that by AD 2054 the whole of the US defence budget will buy only a single combat aircraft.\textsuperscript{107} New technologies, however, reduce the number of aircraft and weapons needed for operational missions and increase operational capability. They also help in reducing attrition rates and increasing accuracy and reliability of systems. Air power today has, therefore, become vastly more cost effective than it was in the

Second World War. The Hurricane and Spitfire aircraft of the Second World War were capable of only day-light operations, with a radius of action of about 160km and fitted with weapons which had a single shot kill (SSK) probability of just one per cent. Today's Tornado F-3 is all weather, day and night, Mach 2+, with unlimited range by in-flight refuelling and with SSK probability of 90 per cent. 108

Cost of new technology systems also depends on production run. If more systems are produced they are less expensive. The former Soviet Union produced thousands of MiG-21s, amortising the design and infrastructural cost, and providing a very cheap fighter for the Third World countries. On the other hand, low production rates boost aircraft and weapon cost. To overcome this, several of the European countries have been joining hands in designing and producing aircraft in larger numbers, like the Jaguar and the Tornado, which are common to their inventories. New technology may often save on cost as in the case of carbon fibre material for the construction of aircraft airframes, which has reduced costs by 40 per cent. New technology systems are also more reliable.

108

ibid, p. 51.
Low technology weapon systems in large numbers are likely to prove too inefficient in warfare on the modern battlefield, and costly as well, since they may prove ineffective against new technology weapons. In air warfare quality engendered by new technology systems is particularly important and, therefore, an air force has no option but to go for quality i.e., high technology.

In developing countries like India a trade-off has to be made between quality and quantity and the answer in these countries may be a mixed package of established lower risk technologies and state-of-art technology weapons at the same time laying emphasis on acquiring multi-role system to provide flexibility in roles.

However, the new technology weapon systems have to be developed and procured to play a role within the framework of air power doctrines and strategies. And therefore, it is vital to evolve a set of doctrines and strategies for the Indian security environment in which the need for new technology weapons can be realistically evaluated.

According to Air Marshal CV Gole, former Deputy Chief of the Air Staff "technology asymmetry in war can be
decisive, but technology for its own sake is dangerous. Technology as applicable to a nation's military doctrine and requirements is what should be pursued. However, the following factors should be taken into account:

1. High cost of new technology.
2. Operational complexities/user friendliness.
3. High technology maintenance problems could be counter-productive if not taken care-of.
4. Ruggedisation/Battle Fog
5. Likelihood of 'over-Kill'/economy of force.
6. Development of system and lead time for induction.

Overriding all, a threat scenario leading to operational environment over the next decade or two will determine the type of technology and weapon systems.''

Appendix 'T' gives a comparative analysis of the performance of MiG-29, Mirage-2000 and F-16 aircraft. It would be clear from the analysis that the performance capabilities of these three modern technology aircraft are almost similar and the success in combat between these types would depend mainly on pilot training, morale, and other infrastructural support systems. Therefore, the likely acquisition of 38 F-16 aircraft by Pakistan should
not worry India so much as the setting up of other combat support services like an integrated air defence radar network, and C3I system which would enhance the entire operational environment for the benefit of the Pakistani Air Force. Air Forces of both India and Pakistan contain in their inventory aircraft which are of old vintage and will not survive in the battle with high technology aircraft. This in itself demands an acquisition programme to replace life expired systems. India, with its aircraft industries and a solid technological base is in a better position to take advantage of emerging technologies in military aviation and produce for the use of the Indian Air Force state-of-the-art aircraft, avionics, and support systems like the AWACS, C3I, in-flight refuelling aircraft, and precision guided munitions. However, efforts in this direction would produce result only if there is total integration of operational strategies and operational requirements are clearly defined. This can be done only if a suitable doctrine is evolved for each service in the larger framework of joint operations.

Air Force Modernisation Programme Vital for National Security

India faces a three-dimensional threat: from Pakistan in the north-west; from China in the north-east; and
from the navies of major powers in the Indian Ocean. To deal with them India needs a highly mobile and flexible power projection capability which can be provided only by a modern air force. Because of our economic constraints, we cannot afford to have large forces deployed all along our entire land and sea frontiers. However, modern airpower can provide the mobility to move forces from one sector to another without delay. Air force squadrons can move from their bases in central India to any threatened sector within 24 hours. Similarly, air lift capability, if provided to the Indian Air Force, along with the use of civil airlines' air lift capability, during emergency and war, could move large formations of ground forces from north-western to north-eastern sector or from the north to the south of the country to take care of threats in the Indian Ocean.

From Douhet to Schwarzkopf, the stream of conceptual thought has confirmed the vital need for air power to achieve and maintain "command of the air", by counter-air operations, and simultaneously carry the war to the heart of the enemy's war-fighting potential while mounting counter-surface operations along with the ground and sea forces. In nuclear or conventional warfare as well as in low intensity conflicts as in Bosnia, modern air power
A new technology based air force in being, is an effective deterrent because of its quick reaction, surprise, speed, reach, and concentration of firepower.

However, modern air power requires combat support systems which act as 'force multipliers' and provide greater punch with limited strength. These combat support systems are even more important for developing countries with limited resources. Some of these are listed below.

1. Strategic and tactical intelligence support.
2. In-flight refuelling system.
3. Military airlift capability (including civil airlines).
4. Air-borne warning and control system (AWACS).
5. Command, control, communication, and intelligence system (C³I).
6. Joint surveillance, tracking and reconnaissance system (JSTARS)
7. Electronic warfare systems.
8. Remote piloted vehicles/unmanned aerial vehicles (RPVs/UAVs)

For cost effective employment of modern air power, the entire combat element of fighter and bomber aircraft,
and the combat support systems listed above will need to be closely integrated in a joint plan based on a force doctrine and air strategy to achieve the political aim. The political and military organisations at the top level would need integration so that they can play an important role in the success of air operations in the modern battlefield.