CHAPTER III

MILITARY R&D PROJECTS: OBJECTIVES

3.1 SECURITY ENVIRONMENT

This section discusses the security environment of India from the 1970s till the mid-eighties, so as to explain the security concerns that had engaged India around the time that it had inaugurated the major weapons development projects.

India's security perimeter is not limited to South Asia. The developments in West Asia and South East Asia have a bearing on India's security considerations. Enhanced military capabilities of China and Pakistan, the strengthening of political and military ties between the two countries and Pakistan's close relations with "Saudi Arabia and a number of other Islamic states could not but cause anxiety in India". Besides, the presence of extra-regional navies in the Indian Ocean, too, have an impact on India's security environment. India has to address the vulnerability of Andaman and Nicobar islands, safeguard sea lanes of communication and offshore oil installations and Exclusive Economic Zone (EEZ).

After the 1971 India-Pakistan War, India emerged as the pre-eminent state in South Asia. However, during the 1971 War, India faced 'gunboat diplomacy'. An American naval task force led by the nuclear-powered USS Enterprise entered the

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Bay of Bengal\(^3\) in a show of solidarity with Pakistan. This raised the question whether the U. S. would not resort to a similar attempt in the future in order to coerce India.

The coalitions that were formed ahead of the 1971 War—India and Soviet Union having signed a Treaty of Peace, Friendship and Co-operation and the Islamabad, Washington, Beijing axis—have had a chequered history since then.

With Soviet troops moving into Afghanistan in December 1979, India-Pakistan rivalries got intertwined with superpower competition, resulting in the deterioration of their relations, thereby worsening the security climate. India realised that superpower rivalry on the sub-continent had a destabilising effect and necessitated "extra vigilance ... to shield [the country] from any possible adverse consequences of these rivalries or their consequent impact on the region ..."\(^4\). As a result of the Soviet invasion of Afghanistan, "the U. S. resumed a security relationship with Pakistan in June 1981"\(^5\), and with this came the U.S. $3.2 billion (peanuts) military and economic assistance\(^6\). The massive arming of Pakistan as a ‘frontline state’ has continued, and it was India’s “experience that any augmentation of Pakistan’s military strength has, in the past, resulted in its use against India”\(^7\). India held that several of the land-based weapons supplied to Pakistan and the augmentation of the Pakistan Navy’s strength had no relation to the Afghan crisis\(^8\). India expressed its concern at the arming of

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\(^3\) Mihir Roy, *War in the Indian Ocean* [New Delhi, 1995], p. 212. The task force—Task Group 74—comprised of an amphibious assault ship, three guided missile ships, four destroyers, nuclear attack submarines and tankers, besides the aircraft carrier USS Enterprise


\(^6\) MoD, *Annual Report, 1982-83* [New Delhi, 1983], p.1. The amount of U.S. $3.2 billion, then Pakistan President, Gen. Zia, quipped was peanuts.


\(^8\) MoD, *Annual Report, 1985-86* [New Delhi, 1986], p. 3.
Pakistan more explicitly when it feared that induction of 'patently offensive arms' into Pakistan did not augur well for peace in the region. Some of the sophisticated weapon systems acquired by Pakistan included TOW and Harpoon missiles, Vulcan phalanx air defence equipment, Mohawk battlefield surveillance aircraft and Hawkeye early warning system. The military assistance provided to Pakistan triggered a rush for arms by both India and Pakistan. In response to the American supply of F-16 aircraft to Pakistan, India entered into an agreement with France in 1982 for the purchase of forty Mirage-2000 fighter aircraft. In response to the fears expressed by India over Pakistan's acquisitions, the Soviet Union 'almost automatically' agreed to meet India's conventional arms requirements; India was supplied with the MiG series of aircraft.

The issue of nuclear proliferation in South Asia assumed a high profile when reports of China having collaborated with Pakistan in the later testing its 'atomic related mechanisms' in China, came in. Without directly naming China, the Ministry of Defence Annual Report noted:

Pakistan's relentless pursuit of nuclear weapons capability with the connivance of certain countries added a new dimension to our (India's) security environment.

Furthermore, the disclosure made by Dr. A.Q. Khan and on the strength of the evidence that India had collected, India concluded that Pakistan was 'on the brink' of

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9 MoD, Annual Report, 1983-84 [New Delhi, 1984], p. 1. The Report says, "Induction of arms into a troubled area where the leadership does not have a strong democratic base could be a cause of instability and pose a threat to peace".

10 See Appendix C, "Trade in and Licensed Production of Major Conventional Weapons: Imports", in Chris Smith, India's Ad Hoc Arsenal [New York, 1994], p. 231.


acquiring a nuclear weapons capability, which had the 'most serious consequences' to its security\(^\text{13}\).

Moving further Southwest, war commenced in September 1980 between Iran and Iraq, both members of the Non Aligned Movement (NAM). This, India felt, aggravated the already existing tension in the region, at which India expressed its 'concern, anxiety and apprehension'\(^\text{14}\).

During the 1980s, India felt concerned at the arms acquisitions of the oil-rich states of West Asia\(^\text{15}\). The reason for the concern stemmed from the fact that Pakistan, India’s adversary, had close relations with the countries of West Asia. “The accumulation of petro–dollars in [West Asia] led to the... large scale purchase of sophisticated purchase of arms by Iran, Iraq, Saudi Arabia, Libya, and some of the Gulf sheikhdoms\(^\text{16}\).” Besides, during the mid–seventies, Iran embarked upon a massive weapons acquisition programme. At that time, Iran purchased “F-16 and F-14 Tomcat fighters, AWACS, Phoenix missiles, Spruance–class destroyers and British Chieftain tanks\(^\text{17}\).” The reason that India perceived a threat in the weapons acquisitions of the West Asian countries was that there was the likelihood of those weapons being transferred to Pakistan\(^\text{18}\).


\(^{16}\) Ibid., p. 37.

\(^{17}\) Raju Thomas, *India’s Security Policy* [Princeton, 1986], p. 38.

3.2 OBJECTIVES OF THE INTEGRATED GUIDED MISSILE DEVELOPMENT PROGRAMME (IGMDP)

3.2.1 Guided Missiles

Guided missiles have high destructive power; they can be delivered with accuracy irrespective of the distance from which they are launched; they are cheap to produce and can be mass produced; they are easy to operate and for operating them the troops do not require to possess high technical skill\(^9\). An interest in guided missiles was ‘triggered’ after witnessing the performance of laser-guided Paveway in the 1972 Vietnam War. Some examples of early Precision Guided Munitions (PGMs) include the Soviet Sagger wire-guided anti-tank missile, the American TOW missile, the Franco-German HOT missile, both of which operated on semi-automatic guidance and the British Swingfire missile, that was less automatic than the TOW and HOT missiles\(^2\).

3.2.2 Early Thinking on Missiles

India’s interest in missiles dates back to the time of Tipu Sultan, the ruler of the Karnatic during the medieval period. As early as in 1958, the year the Defence Research and Development Organisation (DRDO) was formed, the then Scientific Advisor to the Defence Minister, D. S. Kothari, declared unambiguously that ballistic missiles were “undoubtedly [one of] the greatest and most portentous

\(^{19}\) United Service Institution of India, Review of the Organisational Pattern of the Indian Army, Report of a Seminar, New Delhi, 26 March 1976, p. 34. During the mid-seventies the cost of a PGM was £ 5,000 and that of an aircraft was £ five million. See the presentation by Maj. Gen. (Retired) D. K. Palit.

problems... The reason for anxiety was the great reach that ballistic missiles have. Tipped with a nuclear warhead, the dangers only multiplied. Even at that time missiles and rockets formed one of the areas in which defence R&D was planned to be conducted. Writing in 1967, after the Chinese had conducted nuclear tests, besides discussing Chinese nuclear and delivery capabilities, the then Scientific Advisor to the Defence Minister, Suri Bhagavantam writes:

An aircraft industry has been developed in India... An Indian-designed twin jet fighter, the HF-24 Marut, is in production... It is to be expected that the Indian government will be tempted to follow the Marut with another major project; and in theory that could be a bomber... or missile.

Therefore, one could assume that as early as in the late sixties, there was some thinking in India to launch a ‘major’ project on missiles.

The first clear indication that India was seriously considering the idea of launching the Integrated Guided Missile Development Programme came in 1979, when a committee was established, under the Ministry of Defence, with the then DRDO Director General, Raja Ramanna, as the Chair. The committee is popularly known as ‘Missile Policy Committee’. Besides recommending the launching of an ‘integrated missile development programme’, the Committee recommended the:

procurement, development and production of missiles for the three Services, in the short term, as also to build up the infrastructure in certain areas so as to take up projects for development of more sophisticated missiles in the long term.

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22 Suri Bhagavantam, “Nuclear Technology and Delivery Systems”, *Science and Culture* (Calcutta), Vol. 33, no. 9, September, 1967, p. 387. Bhagavantam succeeded Prof. D. S. Kothari to become the second Scientific Advisor to the Defence Minister. A physicist of great repute, he was a close associate of Sir C. V. Raman and was Director of the Indian Institute of Science (IISc), Bangalore.
Why did the Committee use the word 'procurement'? Read with the succeeding words, under the then obtaining security environment, the Committee was perhaps suggesting the outright purchase of missiles as an interim measure, till such time when India was in a position to develop and produce its own missiles. One should also note that the missiles were intended to be produced, and not merely developed. The wording 'sophisticated' used in the recommendation is rather vague. For want of information, it is difficult to even hazard a guess, let alone state definitely what the Committee had in mind. With the advantage of hind sight, one could probably say, though not in a definitive sense, that the Committee may have then had in its mind the future Prithvi and Agni and more.

Thus, it is noticed that a number of missiles of varying range and capable of performing different roles were acquired in the aftermath of the recommendations of the Missile Policy Committee, beginning in 1980, when orders were placed for the acquisition of FROG-7 Surface-to-Surface (SSM) missiles from the Soviet Union.

3.2.3 Past Experience: Anti Tank Guided Missile (ATGM) Development Project\textsuperscript{24} and Devil Project\textsuperscript{25}

The Defence Research and Development Laboratory (DRDL) was sanctioned a project in April 1962 for building competence i.e., expertise, in the design and

\textsuperscript{24} The following presentation is based on Public Accounts Committee(1981-82), Hundred and Thirteenth Report, Seventh Lok Sabha, Ministry of Defence, Development and Manufacture of a Weapon System [New Delhi, 1982].

\textsuperscript{25} Unless otherwise specified, citations on the Devil Project are also based on Ibid.
development of an anti-tank guided missile\textsuperscript{26}. However, ten years after the project was commenced as a competence building venture, it was closed down in 1972.

The missile was planned to be based on wire guidance\textsuperscript{27}. The project, which was initially begun as a competence building project was converted into a staff project in January 1964\textsuperscript{28}. At the time that the project was initiated, ‘it was in an altogether new field of technology; there was neither adequate know-how nor the basic infrastructure’. Contrary to the expectations at the time that the project was commenced, the industry was not able to manufacture the missile as it lacked the required infrastructure. In fact, the DRDL was itself in its ‘infancy’ and there was lack of adequately qualified personnel, basic infrastructure and facilities at the DRDL. All these had to be built from scratch\textsuperscript{29}.

During the course of running the project, one hundred rounds of the missile were test-fired. During user trials, the missile achieved 65 per cent reliability at a range of 1,500 yards and 90 to 95 per cent reliability at a range of 2,000 yards\textsuperscript{30}. It was decided that the missile would not enter service as its reliability and range did not match the requirements of the army. However, the project was not immediately closed down. For, it was felt that continuing the project would enable building up competence in missile technology.

\textsuperscript{26} The project was sanctioned at a cost of Rs. six lakhs.
\textsuperscript{27} Public Accounts Committee (1981-82), Hundred and Thirteenth Report, n. 24, p. 6.
\textsuperscript{28} The difference between a ‘competence building project’ and a ‘staff project’ is that while the former is sanctioned at the initiative of the DRDO so as to enable it to build expertise in the specified field which would be useful at a time when the user makes a requirement for a weapon system the later is sanctioned when the user feels a need for a weapon system. As in this case, some of the competence building projects could be converted into staff projects. \textit{Ibid.}, p. 5.
\textsuperscript{29} \textit{Ibid.}, p. 6 and p. 7.
\textsuperscript{30} \textit{Ibid.}, p. 7.
The experience in running the project resulted in 'learning design technology and evaluation techniques', besides facilitating the appreciation of 'problems' associated with developing a complex missile system\textsuperscript{31}.

The ATGM project was closed down and it did not ultimately meet the needs of the army, which had to make off-the-shelf purchases of ATGMs from France. This gave rise to the criticism that an expenditure of more than Rs. 28 lakhs on the ATGM project was a waste. For, the project failed to meet the requirements of the army. The ATGM project is a typical example of the dilemmas of defence R&D effort in India. If a project is never commenced on the basis of a foregone conclusion that it would not ultimately contribute to technological self-reliance and self-sufficiency in arms production there would never be a beginning and the services shall have to continue to rely on imports. On the other hand, considerable human, material and financial resources would have to be expended, not to speak of the criticism and discouragement that would follow, with the expectation that there may be a turnaround some time in the future. Besides, to meet the immediate requirements of the army, imports have to be made, which would involve additional expenditure.

In the case discussed above, the failure of the DRDL to develop the ATGM required by the army resulted in importing ATGMs from France. This involved an expenditure of Rs. 392.37 lakhs on the weapons, Rs. 23.47 lakhs on the ground equipment (vehicle to mount the weapons) and an additional Rs. 17.37 lakhs for an improved version of the vehicle on which the weapon was mounted\textsuperscript{32}. Together—the

\textsuperscript{31} Ibid.
\textsuperscript{32} Ibid., p. 9.
amount spent on the project and the cost involved in importing the ATGMs and a suitable mount—it had cost the exchequer a sum of Rs. 4,61,93,700.73. Moreover, Rs. 94.52 lakhs were paid as licence fee for the indigenous production of the missile and the associated ground equipment.

The experience that was gained during the course of developing the ATGM had enabled the DRDL to undertake the development of Surface-to-Air missile (SAM) (the code name given to the project was ‘Devil’), which was test fired in 1978 for a range of 35 km. The ‘Devil Project’ was abandoned in 1979. Though all the reasons for the failure of the Devil Project are not known, it is believed that one of the "major handicaps was time-consuming bureaucratic bottlenecks". The achievements of the Devil Project included the development of propulsion technology, guidance and control systems.

3.2.4 Modernisation, Effectiveness

By the early 1980s, many of the missiles that were in use became obsolescent. The ENTAC ATGM was purchased in 1969 from France while the licensed production of the SS-11 ATGMs under an agreement with France, began in 1968 and was replaced by the next generation French Milan 1 and Milan 2, initially purchased in 1982 and produced under license beginning 1984. The SAMs in the Indian inventory also belonged to the 1960s. The Soviet SA-2, SA-3 were ordered for in 1964 and 1967 respectively. These made way for the second generation SAMs that were inducted

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33 Ibid., p. 7.
viz. the Soviet SA-7, SA-8 and the SA-11. Most of the ship-based missiles belonged to the 1970s.

Missiles are developed for the military benefit they bring to the country that possesses them; when used against an adversary. They can inflict damage on an adversary's armed forces or strategic locations. If the missile uses guidance technology, it could be delivered with accuracy, from afar. During the late seventies, it was argued in the English press in India that a whole range of missiles should be developed. While the advantage of the use of missiles, as was evident in the case of the Gulf wars, was appreciated, it was also argued that unlike an aircraft which would have to enter enemy territory to attack targets—wherein the safe return of the aircraft and the pilot was not assured, since an aircraft was likely to be intercepted and struck down—a missile would be able to perform similar function without the risks attending an aircraft. 37

At a seminar organised in Delhi in 1976, senior retired army officers made a strong case for inducting missiles into the army. A retired Brigadier pointed that a second or third-generation anti-tank guided missile was required by the army to be employed in areas where the troops had to adopt a defensive posture. This would “reduce dependence on armour, thus releasing it for offensive employment” 38. At the same venue another retired officer, a Major General, drew attention to the advantages of guided missiles 39.

37 A. C. Cariappa, “Missile Gap in the Army”, The Hindu (Madras), 22 March 1979; V. N. Gadgil’s address to the Institute of Armaments Technology, Pune, reported in Indian Express (New Delhi), 29 November 1976; Inder Malhotra, “Producing for Defence”, Times of India (New Delhi), 16 November 1977; K. P. Candeth, “The Case for Deep Strike Aircraft”, Indian Express, 8 November 1977; The Hindu, 25 October 1977. Even before the Missile Policy Committee was constituted, the Devil Project, which was subsequently wound up, was launched.

38 United Service Institution of India, n. 19, p. 29. The suggestion was by Brigadier (Retired) R. D. Law.

39 Ibid., p. 34.
Guided missiles have high destructive power; they can be delivered with accuracy irrespective of the distance from which they are launched; they are cheap to produce and can be mass produced; they are easy to operate and for operating them the troops do not require to possess high technical skill. Besides, it was anticipated that Pakistan would acquire PGMs for use in a future war. Hence, the argument went, it was necessary on the part of India to equip itself with similar weapons.

3.2.5 Self-Reliance

Apart from these, India was faced with the unwillingness of the Soviet Union to sell the more advanced and larger missiles. In any case, missile technology is not sold for the asking. Abdul Kalam himself stated that India would not sell the Prithvi design or fabrication process. Besides, discussions on controlling missile technologies were being conducted in utmost secrecy in the early 1980s among the developed countries. Even before the IGMDP was launched it was anticipated that India’s request for advanced missile related technologies would be denied. Therefore, it was realised that India had to depend upon itself for the development of missiles. It was in this background of increasing security concerns—of a nuclear China, and of a nuclear-capable Pakistan, a quest for self-reliance and the requirements of modernisation and the advantage of effectiveness of guided missiles that the IGMDP was launched.

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3.2.6 The Path to IGMDP

It was almost around the time that the Missile Policy Committee was set up that the Devil Project was wound up. DRDL, the lab responsible for developing missiles, was in need of an accomplished project manager. With this in view, the then DRDO Director General, Raja Ramanna, suggested in 1981 that Abdul Kalam be appointed director of DRDL, to run the missile development project42. Eighteen months later Abdul Kalam was appointed Director DRDL. Abdul Kalam led the team that successfully concluded the SLV–3 project. By this time, a considerable amount of technological, industrial and human resource were also available. For a very long time, space technology and defence technology were kept apart. This is cited as one of the reasons why the missile development programme, meaning the Devil Project, which was by then underway was not making any headway. Hence, it was suggested that it would be advantageous as well as a cost–effective option to establish linkages between space and defence technologies43.

At the DRDL, a high level committee called the ‘Missile Technology Committee’ was formed. Deliberations in this body resulted in the formulation of the basic plan, which was later fine tuned, for the development of guided missiles. Abdul Kalam recently wrote that the IGMDP is a product of a ‘detailed study’ conducted in 1982 “for evolving missile systems in order to counter the emerging threats to the security of India”44. A team was formed under the chairmanship of Abdul Kalam, with Z. P.

Marshal, N. R. Iyer, A. K. Kapoor and K. S. Venkataraman as members, which drew up a paper, with inputs from the three services, for the Cabinet Committee on Political Affairs (CCPA) on the development of indigenous guided missiles\(^{45}\). Subsequently, the proposal was discussed at a presentation presided over by the then Defence Minister, Venkataraman, and finally cleared by the Cabinet. Consequently, the programme was launched on 27 July 1983 at DRDL, Hyderabad, by the then DRDO Director General, V. S. Arunachalam, amidst fanfare, in the presence of a large gathering of scientists, academicians, officers of the armed forces and production agencies. Five projects leaders were selected, one for each of the missile projects, with Abdul Kalam as the head of the entire programme.

"The technological goal of the IGMDP is to ensure that the systems will be contemporary at the time of their induction into the armed forces. The systems have been designed to be multi-purpose, multi-user and multi-role in nature"\(^{46}\). The programme, therefore, intends to develop the variants of a missile system to cater to the needs of the three wings of the armed forces. It is noticed that the shorter range version of the Prithvi missile has been developed for use by the army, while the air force chose the extended range version, and the naval version of Prithvi is in the drawing board stage. Another missile, Trishul, is being developed for use by all the three services. The same could also be true with the Agni missile system. 'Role' and 'purpose' are inter-related. The role in which the missile system would be used would point the target(s) it would hit; i.e., for instance, in the sea-skimming role.

\(^{45}\) Kalam, n. 42, p. 113. They "estimated an expenditure of Rs. 390 crores, spread over a period of twelve years", for the completion of the project.

\(^{46}\) Kalam and Rajan, n. 44, pp. 198-99.
Trishul would target surface vessels. Interpreted differently, the targets that a missile system would hit could be tactical as well as strategic.

It is impossible to state with certainty, because of the lack of documented public evidence, if it was intended to launch a nuclear warhead using the Agni missile system right at the time the IGMDP was launched. The range, technological sophistication and the cost of the missile raised doubts if it would not be used to deliver a nuclear warhead. Probably, it was inconvenient and, hence, not possible to admit that Agni would carry nuclear warheads. In any case, Abdul Kalam himself admitted that the Agni was nuclear capable, but said that it was for the government to decide on the matter. In an interview he said:

It [Agni] can carry conventional warheads. It can also carry flowers to offer as a symbol of peace... It can also carry nuclear warheads... We provide the carrier and the policy makers decide how to use it\(^{47}\).

3.2.7 Exporting the missiles

The missiles being developed under the IGMDP have export potential. Though no public statement has been issued in this regard it is believed that some or all of them may be put up for sale. For instance, in the aftermath of the launching of Agni, the possibility of all the five missiles of the IGMDP being included in the list of defence equipment that was likely to be exported was raised in media circles\(^ {48}\). Later, it was reported that President Nelson Mandela made inquiries during his state visit to India

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\(^{47}\) See interview by Amarnath K. Menon with Abdul Kalam, who was at that time the Director of the DRDL, soon after the first test-launching of Agni, “We Can Design Any Missile”, India Today, 15 June 1989, p. 31.

about purchasing the anti-tank missile Nag\textsuperscript{49}. The point being made here is that exporting the missiles being developed under the IGMDP was not one of the objectives for commencing the programme. However, the possibility of their export in the future was not ruled out, especially because the suppliers are very few while the buyers are many.

3.2.8 Prioritising the development of missiles

It is noticed that among the five missiles being developed under the IGMDP, the \textit{Prithvi} missile was the first to be handed over to the user, while the rest are in various stages of development. Besides, the \textit{Prithvi} missile crossed all milestones, except one, ahead of the other missiles being developed. Therefore, it would be instructive to identify if there was a plan to accord priority in the development of these missiles.

Probably, the availability of technologies that go into the making of these missiles enabled according greater attention, if not priority, in the developing of each of the five missiles. Foremost, the hands-on experience of Abdul Kalam in the Satellite Launch Vehicle (SLV) project and the competence building activities undertaken at DRDL, prior to and during the Devil Project, favoured the early completion of the \textit{Prithvi} missile project, right from the beginning. In so far as the other missiles' development was concerned, there existed some technological strengths, but there were missing links. For instance, in the case of \textit{Agni}, the crucial technology required for designing the heat shield was not available at that time in the

\textsuperscript{49} \textit{The Hindu}, 1 August 1998. The report quotes the Chief of Army Staff and states that India and South Africa were making preparations for institutionalising their military ties through 'regular dialogue between the Defence Ministers, Service Headquarters and Military Scientists.
country, though work was swiftly progressing. A technology development project for designing the heat shield was initiated at the behest of Abdul Kalam\(^{50}\), just a little before the IGMDP was formally sanctioned by the government.

Abdul Kalam brings out an interesting fact in his recent autobiography. Not knowing that the then Defence Minister, Venkataraman, would, in fact, ask the DRDL to undertake development work on all the five missile systems in an integrated fashion, Abdul Kalam and his ‘team’ suggested in their paper to the CCPA that the missile development programme would be undertaken in two phases: a Tactical Core Vehicle (TCV)—(the latter day Trishul), and a surface-to-surface weapon system in the first phase; and in the second phase, a surface-to-air medium range weapon system with capability for multiple targets—the latter day Akash, and a third generation fire-and-forget anti-tank missile system—the latter day Nag\(^{51}\). It emerges from the above that in a vague way, at least, there was a prioritising according to the development of the missile systems. Clearly, if limited funds were allocated to the development of these missiles, this prioritisation would have been implemented.

Abdul Kalam does not explicitly write whether developing the Agni missile system was at this point of time a part of their proposal. Of course, he ‘longed’ to develop such a missile system, and had, hence, ‘persuaded colleagues’ to undertake work that would later facilitate the development of the heat shield for the Agni missile system\(^{52}\).

\(^{50}\) Kalam, n. 42, p. 114.

\(^{51}\) Ibid.

\(^{52}\) Ibid. Kalam refers to it as the Re-entry Experiment Vehicle (REX).
3.3 OBJECTIVES OF LIGHT COMBAT AIRCRAFT (LCA) PROJECT

3.3.1 Past Experience: The HF–24 Marut Development Project

India commenced its first major project for the indigenous design and development of jet aircraft in 1956, when the HF–24 Marut project was launched. For designing the airframe of the Marut, a team of German engineers led by Dr. Kurt Tank was drafted. It was thought that the German team would train a pool of Indian design engineers at Hindustan Aeronautics Limited (HAL). During the course of the Marut project, one hundred Indian design engineers worked along with the German team for designing the airframe for the Marut. One renowned scholar states that the Germans “worked mainly on their own”\(^\text{53}\). The official sources refute this opinion. It has been claimed that Indian design engineers “gained a fair degree of experience in the design and development of modern high speed aircraft”\(^\text{54}\).

Selecting an engine for the Marut led India first to the United Kingdom, later to Egypt, and then to the Soviet Union. None of these bore fruit. India once again approached the United Kingdom. This resulted in procuring the Orephus–703 engine, which, however, did not lend supersonic speed to the aircraft\(^\text{55}\). The first attempt to procure a British engine for the Marut did not fructify as India asked for modifications, which the British declined to carry out unless the amount that was

\(^{53}\) Raju Thomas, see the chapter “Claims and Costs: The Airforce Defence Programme”, *Defence Of India: A Budgetary Perspective* [New Delhi, 1978], p. 182.


\(^{55}\) Amit Gupta, “Indian Arms Industry: A Lumbering Giant”, *Asian Survey*, Vol. 30, no. 9, September, 1990, p. 849. By this time India was already producing the Orephus–701 engine at the HAL’s Bangalore complex under a license agreement with Bristol Sydley of the United Kingdom.
involved in the modification exercise of the engine was fully paid beforehand. As this was not acceptable to India the plan was abandoned. The details concerning the reason for not following the Egyptian option are scanty. Then, it was proposed to import and subsequently undertake the licensed manufacture of the Russian RD 9F engine. However, this proposal, too, did not fructify. India had suggested modifications to the RD 9F engine with the objective of achieving a speed of mach 2. The Russians assured a speed of mach 1.4 and stated that after carrying out suitable modifications, a maximum speed of no more than mach 1.7 could be achieved, which they did not, however, 'guarantee'. At this stage “[i]t was realised that with the existing resources and technical know-how it may not be possible to develop [the] RD 9F engine for [m]ach 2 performance..., [especially] when the Soviet authorities themselves had expressed... doubts as well as inability to do so”\textsuperscript{56}.

In view of the difficulties encountered in finding a suitable engine for the \textit{Marut} aircraft, the Committee on Public Undertakings recommended that ‘sustained efforts’ should be made by the HAL to indigenously design and develop aircraft engines that had a performance speed of mach 2. In response to this, the government informed the Committee on Public Undertakings that its recommendation would be put into practice subject to the availability of financial and other resources\textsuperscript{57}.

\textsuperscript{56} Committee on Public Undertakings (1967-68), \textit{Eighth Report}, Fourth Lok Sabha, Ministry of Defence, Department of Defence Production, \textit{Hindustan Aeronautic Limited} [New Delhi, 1968], p. 66. The proposal also involved modifying the airframe to suit the installation of the engine. The proposal of powering the \textit{Marut} with a Russian engine was pursued between 1961 and 1963. The exercise involved an expenditure of Rs. 2.39 crores, which ultimately to be ‘infructuous’.

\textsuperscript{57} Committee on Public Undertakings (1969-70), \textit{Sixtieth Report}, n. 54, pp. 16-17.
There were other difficulties which the project encountered. These were in the realm of prototype development and production. As the HAL had no previous experience in the indigenous design and development of aircraft, but was till then occupied in the their licensed manufacture—Prentics, Vampires and Gnats—there was a lack of both experienced and adequately qualified skilled production personnel, which resulted in inadequate planning, thus causing time-slippage.

The first prototype made its maiden flight in June 1961, the second in October 1962 and the first batch of the aircraft was delivered to the air force on 10 May 1964—eight years after the project was initiated. Though the Marut was finally delivered, the indigenous content of the aircraft was only partial. It “relied heavily on imported parts and materials”.

The Marut project is an example of poor planning and inadequate appreciation of the problems associated with the development of advanced aircraft in the country. The project was undertaken at a point of time when the higher authorities knew full well that the country was not yet capable of handling a complex project such as the Marut. According to one scholar, the reason for initiating the project was that "with Prime Minister Nehru and the then Defence Minister, Krishna Menon, wanted India to be self-sufficient."
3.3.2 The LCA

The ageing Mig-21s then in the service of the Indian Air Force (IAF) needed to be replaced at the earliest, if not immediately. At that time, efforts were being made to upgrade the indigenously designed HF-24 Marut into a deep penetration strike aircraft, for the need for such an aircraft was expressed by the IAF. However, these efforts did not bear fruit. In any case, even if these efforts materialised it was feared that the aircraft would become obsolescent by the time it entered service.

Speaking at the annual Air Force Commanders Conference in 1982, the then Defence Minister, R. Venkataraman, stated categorically that the country was not in a position to make available the foreign exchange required for the procurement of aircraft from abroad to meet the requirements of the IAF and urged the Services, R&D organisation and production agencies to 'have the closest co-operation' with a view to evolving ideas and designs in order to meet the country's requirements. Further the Defence Minister expressed the hope that projects like the LCA would help realise the goal of self-reliance.

One of the earliest reports on the government having committed itself to the LCA project surfaced in September 1983. The then DRDO Director General, Arunachalam, while making a speech after inaugurating the Centre for Aeronautical Systems Studies and Analyses (CASSA) in Bangalore, disclosed that the government had sanctioned a Rs. 600 cr.-worth LCA project. One commentator inquired, nearly one and a half years before the project was officially launched, of the progress.

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61 Tribune (Chandigarh), 5 December 1974.
63 Statesman (Calcutta), 17 September 1983.
made on plans supposedly to design an LCA. Around the same time, another commentator, too, mentioned the LCA, and came down heavily on the lackadaisical attitude of the powers that be towards aircraft development projects.

Interesting disclosures have recently been made in a rejoinder volley amongst those who conceived the LCA project. As it transpired, a change was affected in the goals of the LCA project between the time that it was initially discussed and the approval was given for its commencement. In the opinion of the then Chief of Air Staff, I. H. Latif, the IAF required a light aircraft that could perform the simple role of according tactical air support (ground attack). However, during the course of deciding the functions that the future light combat aircraft would perform it was felt that it should be a multi-role aircraft, which would undertake both ground attack and interception operations. Doubtless, it is desirable to design such an aircraft. The advantage is that multiple models, each performing a specific role, could be avoided. This would reduce the strain on the air force budget. But, the question is, was there adequate capability in India to design a multi-role aircraft? The DRDO answered in the affirmative and the air force was too happy to receive such an assurance.

Later, it became known that a high-level team, headed by the former Director of the National Aeronautics Laboratory, who was later appointed the over-all in-charge of the LCA project, visited foreign aeronautics companies in 1980 to study the feasibility and gauge the capability of developing and manufacturing light

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64 *Deccan Chronicle* (Hyderabad), 23 February 1982.
65 Jagan Chawla, "Who Plans India’s Defence?", *Times of India*, 1 April 1982.
combat aircraft in India. The team was of the unanimous opinion that it, indeed, was a workable proposition.\(^66\)

### 3.3.3 Aircraft Purchases

The timing of broaching the idea of developing the LCA indigenously and it finally obtaining the government’s approval are important. Preceding the launching of the project, India had signed aircraft deals for off-the-shelf-purchase and or licensed manufacture of aircraft with the U. K., France and the (erstwhile) Soviet Union, all in quick succession. Besides, it was around this time that the U.S. and Pakistan entered into a special relationship in the wake of Soviet troops moving into Afghanistan, and, as part of a larger package, the U. S. agreed to sell F–16s to Pakistan. The British Jaguar deep penetration strike aircraft (DPSA) deal was clinched during the Janata Party regime and before the LCA idea came forth. The French Mirage deal and the Soviet MiG deal were signed by its successor, the Congress Party government. Pakistan’s acquisition of F–16s may have little to do with the Indian plan to indigenously design and build a light combat aircraft because the idea of the LCA project was mooted before the U. S.–Pak deal. The deal impinged upon the LCA project to the extent that the future workhorse of the IAF had to be as agile as the F–16.

A lone report, that too originating in Pakistan, suggests that India agreed to buy the Mirages after France expressed its willingness to collaborate in the development

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of the Indian LCA\textsuperscript{67}. This seems to be a rather farfetched idea, for the French did not provide any large-scale collaboration. In fact, it was the United States that provided a considerable degree of assistance. Of course, the French acted as consultants during the preparation of the feasibility report.

3.3.4 Self-reliance: The key objective

The then Air Chief, Da La Fontaine, expressed his unhappiness with the way aircraft procurement plans were carried out and said, "...there has to come a time when we stop buying and start designing and producing... we should be self-sufficient..."\textsuperscript{68} in aircraft production.

Laying stress on the rising costs of aircraft procurement from abroad and hence the imperative for indigenous programmes, Fontaine’s successor Mehra stated unequivocally that the future of the Indian Air Force depended upon indigenous programmes. To quote Mehra\textsuperscript{69}:

...if we do not commit ourselves to the programme, the Indian Air Force would, if you do not take me literally, cease to exist after the turn of the century because things would be so expensive that one would not have the money to buy them [aircraft]...

That achieving self-reliance in aircraft designing and production was the objective behind launching the LCA programme was reiterated by the then Minister of State for Defence, Krishna Kumar, when he said in the Parliament, "The objectives of the LCA programme are to design and develop a fighter aircraft indigenously with selected assistance from abroad and also to bridge design capability in the aeronautical

\textsuperscript{67} A. R. Siddiqui, "India’s Hectic Arms Shopping", \textit{Dawn} (Karachi), 1 February 1984.
\textsuperscript{68} See interview with Air Chief Marshall Da La Fontaine, \textit{The Hindustan Times}, 8 October 1986.
Further, the Minister stated on the floor of the House that, alternatively, the requirements of the Indian Air Force could have been met either through outright purchase of aircraft or through licensed manufacture or a combination of both. One could aver that the devaluation of the rupee and foreign exchange crunch not only prompted the government to launch the LCA project but had also influenced the decision in October 1991 to increase the indigenous content in the LCA.

3.3.5 Role and Variants

In 1986, the then Chief of Air Staff said that the IAF was looking forward to the LCA replacing the Jaguars and the Mirages, which was why India would not be manufacturing them. It, therefore, can be established that at the time of launching the LCA programme one of the objectives was to develop the LCA as a multi-role aircraft. Though La Fontaine stated in his interview that the LCA would also be a replacement to the Jaguars, evidence now suggests that it shall not be the case. The reason is that the Jaguar is a deep penetration strike aircraft and such a role is not envisaged for the LCA. The LCA has been “designed as an air superiority fighter, it has an excellent offensive air support and interdiction capability... [it shall] replace the Mig series of aircraft... [but] cannot do deep penetration strike role. Though there is no evidence to suggest that several derivatives of the LCA were planned at the time of launching the programme itself, with the advantage of

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70 See India, Parliamentary Debates, Rajya Sabha, Official Report (henceforth RSD), 27 February 1992, Budget Session, Q. No. 741. The question was raised by Suresh Kalmadi.
71 Ibid.
72 Ibid.
73 The Hindustan Times, 8 October 1986.
hindsight one could now say the same, because a naval version of the LCA is now at the drawing board stage.

### 3.3.6 Exporting the LCA

It is significant to note that India, which has been equipping its airforce either through off-the-shelf purchases or licensed production, may export the LCA. "LCA, once operational, will have [a] large export potential..."\(^{75}\). The LCA is one of the most cost-effective aircraft belonging to its class. According to an estimate provided by Abdul Kalam, the LCA would cost 21 million dollars\(^{76}\). Table 3.1 below provides a comparative cost-estimate of the LCA and other aircraft belonging to its class.

<table>
<thead>
<tr>
<th>Aircraft and Country</th>
<th>Cost (in millions dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCA (India)</td>
<td>21</td>
</tr>
<tr>
<td>Rafale (France)</td>
<td>48</td>
</tr>
<tr>
<td>EFA (The U.K.)</td>
<td>37</td>
</tr>
<tr>
<td>F-22 (The U.S.A.)</td>
<td>59</td>
</tr>
</tbody>
</table>


### 3.4 OBJECTIVES OF ARJUN MAIN BATTLE TANK PROJECT

#### 3.4.1 The Vajayanta tank

With a view to equipping the army with modern battle tanks during the Third Five Year Plan (1961-'66), an agreement was reached with the British company Vickers and Armstrong to manufacture under license a modified version of their Chieftain

\(^{75}\) Kalam, n. 41, p. 18.

main battle tank, the first of which rolled out of the Heavy Vehicles Factory (HVF), Avadi, on 29 December 196577, almost in under five years from the signing of the agreement and nearly within three years from the time the factory became functional. Sanction was accorded in 1961 for setting up the Heavy Vehicles factory at Avadi for manufacturing the \textit{Vaijayanta} tanks78. While the HVF provided the turret, engine, gear box and some of the main assemblies, the vision and sighting equipment were manufactured in Ordnance Factories and the electronic equipment at Bharat Electronics79. A total of 1,425 \textit{Vaijayanta} tanks were produced under license at Avadi80.

The chief features of the \textit{Vaijayanta} tank are as under81:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>40.4 k. g.</td>
</tr>
<tr>
<td>Length</td>
<td>90788 m</td>
</tr>
<tr>
<td>Width</td>
<td>30168 m</td>
</tr>
<tr>
<td>Height</td>
<td>2.711 m</td>
</tr>
<tr>
<td>Max. Road Speed</td>
<td>48.3 k. m. p. h.</td>
</tr>
<tr>
<td>Gradient</td>
<td>60%</td>
</tr>
<tr>
<td>Vertical Obstacle</td>
<td>0.914 m</td>
</tr>
<tr>
<td>Fording</td>
<td>1.3 m</td>
</tr>
<tr>
<td>Operating Range</td>
<td>354 k. m.</td>
</tr>
<tr>
<td>Commander's Sight</td>
<td>Periscope binocular and Sighting periscope</td>
</tr>
<tr>
<td>Loader's Periscope</td>
<td>No. 23 Mk–1</td>
</tr>
<tr>
<td>Gunner's Sight</td>
<td>Sighting periscope No. 30 Mk–1</td>
</tr>
<tr>
<td>Day Vision</td>
<td>(Commander) Episcope No. 7 Mk–1 (M1) (Driver) Periscope AFV 101A</td>
</tr>
</tbody>
</table>


78 See A. L. Venkateswaran, \textit{Defence Organisation in India} [New Delhi, 1967], p. 301. The tool room of the factory was commissioned in 1963.


80 See “Appendix C: Trade in and licensed production of major conventional weapons: imports by India and Pakistan, 1950–1992”, n. 10, p. 239.

Night Vision
: (Commander) Periscope, Armoured vehicle, IR 101A
: (Gunner) Sight periscope, Armoured vehicle, IR 102 C
: (Driver) Binocular, Armoured vehicle, IR 101A

Engine
: Leyland L 60 developing 535 h. p. at 2,375 r. p. m.

It was disclosed in mid-1993 that some of the Vaijayanta tanks would be upgraded, though the numbers and the extent to which these were to be upgraded was uncertain. It was expected that the modifications would include:\(^{82}\):

- Installation of the T-72 M1 MBT engine;
- New fire control system—the Yugoslav SUV-T55A;
- Additional passive armour—the advanced composite Kanchan armour developed for the Arjun tanks;
- Passive night vision equipment, including thermal sights; and
- Land navigation system.

During the 1971 Indo-Pak War, the Army experienced certain shortcomings in the performance of the Vaijayanta tank. The ‘Vaijayanta’s gear box and diesel engine were not sturdy enough under battle conditions, though the performance of its gun was far better than that of any Russian gun’\(^{83}\). Echoing similar opinion, a former Lieutenant-General writes, "The design of the Vaijayanta had the major defect of not being suitable to the dust and heat conditions of Punjab and Rajasthan\(^{84}\). The modifications suggested were carried out. Nonetheless, it was realised that major changes were required if the quality of performance of the tank had to improve. At this stage, a former Brigadier in the Indian Army suggested that it was decided to develop a new tank altogether, because modifying an existing tank could be highly time consuming and could even prove to be counter-productive\(^{85}\).

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\(^{82}\) For details see Ibid


Even as R&D work on the new tank commenced, knowledgeable circles began to suggest features that could be incorporated in the future workhorse of the tank regiments. For instance, it was pointed out that ergonomics was an important factor that the design and development team, Combat Vehicles Research and Development Establishment (CVRDE), needed to give attention\(^86\). As early as in 1974, it was felt that the new tank could possess such features as hydro-pneumatic suspension—to enhance its survivability, contracting cupola—to enable picking up new targets while the gunner engaged those picked earlier, 110 m. m. gun, image intensifier—for better vision, automatic navigator—to place the exact location of the tank while on a cross-country run\(^87\).

#### 3.4.2 Exporting Arjun

It has been decided to export the Arjun MBT. The tank was actually planned to be put on display, for the first time, at Defex-95 at Abu Dhabi. The idea was aborted for it was felt that the export prospects would be better after the tank entered service. According to a 1996 estimate made by the Department of Defence Production and Supplies, the Arjun tank would cost Rs. 10.08 cr. a piece\(^88\).

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\(^86\) A. N. Dar, "Tank for the Eighties", *The Indian Express*, 14 October 1975. Tank ergonomics is extremely important as it would directly affect the ability of the crew to function. For instance, during the Arab-Israeli war the temperature inside the tank rose to a such a level where the crew had to abandon the tanks to save themselves from getting scorched.

\(^87\) See *The Hindu*, 29 October 1974.

\(^88\) See *RSD*, 30 July 1997, Budget Session, Q. No. 821.