Public–Private Partnership in Defence Aeronautics

Why Has the PPP Model Not Caught On in Indian Defence Development Projects?

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India today is one of the fastest growing economies, the most populous country with a huge talent pool, growing infrastructure and a revamped education system. While most of these are fairly recent developments whose effects will only be visible over the next few decades, it is still worth examining why it has not yet made a major impact in the global defence industrial stage. A state-controlled defence Research & Development (R&D) organisation coupled until recently with a state-controlled defence production set-up, has perhaps not garnered the expected effect even after seven decades of independence.

This article examines the ecosystem, both the past and the current, and attempts to find reasons for the lack of advancement in specific areas of defence development. It examines the various players in the game and the role and responsibilities undertaken by each of them, which consciously or otherwise have contributed to the current state of affairs. It then makes

Disclaimer: The views presented in this article are personal to the author based on her past experience. The article was submitted in April 2024.

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ISSN 0976-1004 (print); 2583-7567 (online)

Journal of Defence Studies, Vol. 18, No. 4, October–December 2024, pp. 115–128

out a case for the establishment of a public private entity for major system development in defence aeronautics.

Background—The Major Players

The Customer—Indian Armed Forces

The Indian Armed Forces comprising the army, navy and air force are the most important stakeholders in the game. The responsibility of the armed forces is typically in three main areas, that is, formulation of qualitative requirements/specifications, provisioning of test platforms and acceptance testing of developed prototypes.

Over the years, a mix of political expediency, foreign diplomacy and a constant yen for imported equipment have ensured that the indigenous industrial and production base remains fairly stagnant, constantly looking for ways and means of pushing their fledgling prototypes towards user exploitation.

While the Indian Navy has shown some degree of interest in indigenous efforts by building up their own R&D and design base, it is even today largely dependent on Russian, French and other imported weapons and platforms. It has, however, over the last two decades allowed indigenous sonars, torpedoes, missiles, fire control suites, electronic warfare systems and radars into their arsenal. Most of these have been developed by the Defence Research and Development Organisation (DRDO) and productionised by Bharat Electronics/Bharat Dynamics.

The Indian Army has always been inclined towards proven imported equipment with Russia and erstwhile Soviet Union being the main supplier. DRDO and Defence Public Sector Undertakings (DPSUs) have had a mammoth struggle to get their developed systems accepted by the army. Examples of these include the main battletank Arjun with its decade-long test and evaluation cycle, arms and ammunition by Ordnance Factory Board (OFB), bridging systems and the Multi Barrel Rocket Launcher System (MBRLS)—each of these have had an arduous development cycle followed by a stringent *agni pareeksha* for its acceptance.

But by far the Service to use the least number of indigenous equipment is the Indian Air Force (IAF) barring the recent orders for Light Combat Aircraft (LCA) Tejas. Airborne platforms being prohibitively expensive, the orders placed for Su 30, Rafale, Mirage, airborne surveillance, helicopters, etc., have made a major dent on the foreign exchequer. The silver lining

in the recent past are production orders for LCA Tejas, Advanced Light Helicopter (ALH) Dhruv and Airborne Early Warning & Control System (AEW&CS) Netra, which are expected to provide a major fillip to the Indian industrial base.

In summary, the Indian Armed Forces have traditionally indicated first preference for imported stores while treating indigenous equipment with mild disdain and imposing a 'Best of Brochures' specification on indigenous developers. The recent thrust on 'Atmanirbhar Bharat' has definitely brought renewed hope to the Indian industry and DRDO, with Buy Indian being made the mandatory first choice for production orders.

Developer—DRDO

DRDO, the R&D wing of the Ministry of Defence (MoD) that was established in 1958, is today a conglomeration of about 40 laboratories, each working in a key area of defence requirements. Spanning the entire gamut of Science & Technology, DRDO works on everything from aeronautics and missile systems, to naval and underwater systems, electronics and communication, land-based combat systems and life sciences catering to the needs of the man behind the machine, that is, the soldier. Over the last two decades, a number of systems amounting to about Rs 4 lakh crores have been accepted for induction by the Services. These production orders are the result of two decades of untiring efforts of DRDO laboratories with their counterparts predominantly DPSUs and a few select Indian private industries. However, DRDO has perennially come under massive attack for project delays and for being the reason behind the large import bill of the Services. This is both unfair and unjustified and indicates a lack of understanding of the system by its detractors. The Indian defence acquisition cycle comprises the users, the developers, the production agency, MoD and defence finance—each of which have some role to play in the game. An in-depth analysis of the large import bill is beyond the scope of this article, but it must be appreciated that DRDO is only the developer, dependent on the Services not only for a realistic Qualitative Requirement (QR)/availability of test platforms but also on the system for complex process of contracting. It only develops prototypes and has neither the mandate to productionise the systems nor does it have the power to impose its choice on the users. There are major systemic changes that need to be made and facile comparisons to Defense Advanced Research Projects Agency (DARPA) (a contracting agency, not a developer like DRDO) and cosmetic organisational changes recommended by committees will not solve the problem of the large import bill, for which the entire MoD mechanism

must take responsibility. Notwithstanding the above, the role of DRDO is immensely important in defence and will continue to be so till the fledgling private sector matures to a greater extent and becomes comparable to global private players, namely, Lockheed Martin, British Aerospace, Boeing, etc.

Production Agency

Defence production has over the past been almost wholly with DPSUs and OFB. DPSUs comprising Hindustan Aeronautics Limited (HAL), Bharat Electronics Limited (BEL), BEML, Mazagon Dock Shipbuilders Limited (MDL), Garden Reach Shipbuilders & Engineers (GRSE) as the star players with Mishra Dhatu Nigam Limited (MIDHANI) in a support role. They have been the mainstay of defence production but are constrained (especially in the case of HAL) to a great extent by a huge self-inflicted workload with no commensurate infrastructure and personnel build-up. MDL and GRSE have taken up in the recent past, major initiatives in shipbuilding together with the entry of private sector players such as Larsen & Toubro (L&T).

Similarly, OFB with its about 40 units has been almost the sole player in arms and ammunition. Over the last decade, the private industry such as Solar Explosives, EEL, etc., has entered this domain with some success. In the recent past, efforts to corporatise OFB, indeed long overdue, have been underway, the results of which will only be visible in the years to come. But traditionally both DPSUs and OFB have been caught up in the licensed production of Soviet equipment for a long time and are only recently moving to take on indigenously developed systems for production. It is important that the recent thrust on technology transfers/Joint Ventures (JVs) from foreign Original Equipment Manufacturers (OEMs) do not once again become the conduit for licensed production in Completely Knocked Down (CKD)/ Semi Knocked Down (SKD) form with little technology know-how/know-why absorption.

Ministry of Defence/Government of India

The acquisition cycle is handled by MoD with a Director General (DG) Acquisition as its head. From tendering to the placement of order, it is a long cycle riddled with red-tapism, too many checks and balances and a need to keep a watchful eye on audit/Comptroller and Auditor General of India (CAG), rather than on the expeditious completion of the cycle. Defence finance is also a major player, whose concurrence is required at every stage, adding to the timeline. The result is a moribund system that stands

in urgent need of review and modernisation. Committee after committee has recommended changes but somehow no major improvement has been implemented or is visible.

In light of the foregoing, there exists the need to bring in drastic and ground-breaking measures to overhaul the entire system if India has to change its image from being one of the largest importers to a developer of cutting-edge systems and finally a major exporter.

The following paragraphs will focus on the aeronautics sector, arguably the most technologically complex and challenging domain and also the most cost-intensive, therefore responsible for the large import bill in defence.

Defence Aeronautics: A Complex Technology Challenge

Aeronautics is currently the most challenging domain in the defence portfolio with the possible exception of LCA Tejas, which too has taken a long time to fructify. Major systems in this domain include manned airborne platforms such as combat aircraft, combat helicopters, AEW&C, Unmanned Aerial Vehicles (UAVs), weapons such as airborne missiles and bombs, radars, communication and Electronic Warfare (EW) suites. Each of these involve complex, fast-changing technologies and is software-intensive. Hence command over these technologies is both critical and security-sensitive. Mastery over these systems will go a long way in establishing India as a dominant force in defence technology worldwide.

Till date, India has successfully indigenously developed a combat aircraft (Tejas), airborne early warning & control system (Netra), advanced light combat helicopter (Dhruv), air-to-air missile (Astra), bombs, airborne radar and EW suites. But each of these developments has been long drawn, typically 10–15 years, with a protracted test and evaluation cycle. This is understandable since they were all first-of-its-kind systems being taken up *ab initio* in the country. It will, however, be necessary to escalate the development cycle for the next-generation systems that are now being taken up. The earlier model of development followed by production needs a revolutionary change as the ecosystem in the country today is ripe to draw in production partners right from the start.

We will look at three DRDO projects that stand as examples that it is time to pave the way for a new paradigm in defence development. Three cases of a JV-like model had been proposed in the past, which fell through due to a variety of reasons.

UAV

The Rustom 2 UAV was actually conceived as a Public–Private Partnership (PPP) model way back in 2010, with DRDO the developer, industry as the production agency and users as the customer. The model proposed a cost sharing formula in the ratio of 80/20/10 between DRDO, industry and users. Attempts were made by DRDO to rope in Indian private industry majors such as Tatas, L&T who indicated interest. But this was also the first time that the Indian private industry would be venturing into a major air platform so there was some hesitancy on the part of DRDO to depend on the private industry in view of unknown technology challenges. The project was finally sanctioned with a DRDO/HAL–BEL/users combination in terms of funding. However, the onus fell completely on DRDO to run the project, with PSUs wanting to come in only at the early production stage and users only at the flight evaluation stage. The result was that it remained and continued to be DRDO's baby with others as onlookers, waiting to see success before committing themselves. The project ran into technology challenges/glitches and is today NOT a success story for DRDO.

Aero engine development

The Kaveri engine development, taken up almost simultaneously with LCA development, marked India's foray in building a gas turbine engine for a combat aircraft. It was an ambitious venture as at that time India did not have much of a technology base in what is perhaps the most technology-intensive engineering equipment for defence. The project progressed with Gas Turbine Research Establishment (GTRE) as the nodal laboratory with some technical assistance in terms of design analysis and simulation through academia and with the idea of taking international consultancy/assistance at some stage. Thirty years later, GTRE managed to develop six prototypes of the core engine and reach a technology level of about 70 KN thrust as against the desired level of 80 KN. A prototype was also flight tested in Russia on an IL 76 platform. But thereafter the project came to a standstill and after a number of reviews admitted the need for foreign consultancy and assistance to clear the last mile. A proposal was mooted in 2019 to establish a kind of consortium with DRDO–Indian industry–foreign industry—an international consortium approach, wherein design would be handled by GTRE and a foreign entity while production would be taken care by Indian and foreign industry. This would also enable the production of aero engines in India for the first time. The proposal was obviously resource-intensive

in the range of 20–30,000 crores and hence even today has not seen the light of day—stymied by debates and discussions *ad nauseum*. However, it must be recognised by the policy-makers that if India is to truly become a technology leader, it must create the capability/capacity to build an aero engine within the country, a feat achieved by only a handful of nations worldwide.

Advanced Medium Combat Aircraft (AMCA) development

Following the success of LCA Tekas Mk I, an improved Mk II was sanctioned with a higher rating engine and advanced weapon and sensor suite. The development model to be followed was similar to Mk I with Aeronautical Development Agency (ADA) as the design authority and HAL to take on production. The project sanctioned in 2010 is in the design phase, currently about 12 years late, with flight trials expected later this year.

Meanwhile in 2010, ADA launched a feasibility study for the design and development of AMCA, an advanced fighter radically different from LCA, propelling it into the medium weight category. Conceived to be a fifth-generation fighter, this twin-engine platform would be equipped for the first time with supersonic cruise, stealth and next-generation weapons and sensors. ADA decided to take up a different model for building this aircraft and in light of an improved industry base proposed a consortium of DRDO–ADA/PSU/private industry. The users chipped in by indicating willingness to provide an integration facility close to one of its air bases. This proposal mooted sometime in 2017–18, which would have been path-breaking, was however not taken up, reasons for which remain unclear. The model went through a number of revisions, scrutiny, discussions and debate and was finally cleared by the Cabinet Committee on Security (CCS) in 2024 for the development of five prototypes at a cost of Rs 15,000 Cr after nearly seven years. The model again has ADA as the design authority with HAL as the production partner but with the mandate to draw in the private industry at some stage. The project is again to be fully funded by DRDO as in the case of LCA, which means full accountability is only theirs. It seems the lessons of the past have not yet been learnt by all concerned including Government of India, and the appetite for making radical changes not developed yet.

While these were some major development initiatives spearheaded by DRDO involving the Indian private industry, let us take a comparative look at global efforts.

International Comparisons

Lockheed Martin F35 development model[1]

The Joint Strike Fighter (JSF) initial concept development contract was signed on 16 November 1996, by US Department of Defense (DoD) with two competitors Lockheed Martin and Boeing. Each was awarded US$ 750 million for designing and developing two aircraft as concept demonstrators. Under the contract, these fighters were required to demonstrate Conventional Take-Off and Landing (CTOL), Carrier Take-Off and Landing (CV version) and Short Take-Off and Vertical Landing (STOVL). They were also expected to include ground demonstrations of production representative aircraft systems such as the Preferred Weapon System Concept (PWSC).

Each company was awarded US$ 750 million to produce two aircraft–including avionics, software and hardware. One major change from the previous projects was prohibiting the companies from using their own money to finance development. This limitation promoted the adoption of low-cost manufacturing and assembly techniques, and also prevented Boeing and Lockheed Martin from bankrupting themselves in an effort to win such an important contest.

Five years later, the contract for System Development and Demonstration (SDD) was awarded on 26 October 2001 to Lockheed Martin, whose X-35 beat the Boeing X 32. The SDD budget funded a total quantity of 20 Research, Development, Test & Evaluation (RDT&E) test articles to include six ground test articles and 14 flight test articles for the United States Navy (USN), United States Air Force (USAF) and United States Marine Corps' (USMC) use. Today, there are about a thousand F35s in use worldwide.

Eurofighter consortium model[2]

In 1983, Italy, Germany, France, the UK and Spain initiated the "Future European Fighter Aircraft" (FEFA) programme with the air vehicle having Short Take-Off and Landing (STOL) and Beyond Visual Range (BVR) capabilities. In 1984, a carrier-capable version was added on the insistence of France. Italy, West Germany and the UK opted out of the programme and established a new EFA programme. After a number of changes in the count of member nations, the Munich-based Eurofighter Jagdflugzeug GmbH was established in 1986 to manage the development of the project and EuroJet Turbo GmbH, an alliance of Rolls-Royce, MTU Aero Engines, FiatAvio (now Avio) and ITP was given the responsibility to

develop the EJ200 engine. The aircraft came to be known as Eurofighter EFA from the late 1980s until it was renamed EF 2000 in 1992.

By 1986, the programme's cost had reached £180 million. When the Experimental Aircraft Programme (EAP) programme had started, the cost was supposed to be equally shared by the governments and the industry, but the West German and Italian governments wavered on the agreement and the British government and private finance had to provide £100 million to keep the programme afloat. The production work was divided among the countries in proportion to their projected procurement: BAe (33%), DASA (33%), Aeritalia (21%) and Construcciones Aeronáuticas SA (CASA) (13%).

The Eurofighter Typhoon is unique in modern combat aircraft in that there are four separate assembly lines. Each partner company assembles its own national aircraft, but builds the same parts for all aircraft (including exports): Premium AEROTEC (main centre fuselage), EADS CASA (right wing, leading edge slats), BAE Systems (BAE) (front fuselage, including foreplanes, canopy, dorsal spine, tail fin, inboard flaperons, rear fuselage section) and Leonardo (left wing, outboard flaperons, rear fuselage sections).

Today there are about 500 Eurofighters in use, mostly with the member nations UK, Germany, Italy and Spain.

Just to put the above in perspective, it should be noted that these were development initiatives by developed nations, each with an established pedigree in aircraft manufacturing and indeed suppliers to the global stage. Notwithstanding the same, it is worthwhile to draw lessons from some of these models and tailor them to suit the Indian ecosystem.

Joint Ventures in Indian Defence

Joint Ventures (JVs) worldwide have evolved substantially over the past decade especially among the world's importers, who earlier relied on offsets—the success of which turned out to be fairly limited. Emerging economies with their large import bill represent a good market for OEMs of developed countries,[3] who can use the local industry for manpower, infrastructure and support in navigating local regulations, while contributing technical expertise, training and Intellectual Property Rights (IPR). The local company in turn benefits from exposure to technology and builds up manufacturing capability in key areas.

In India, as of March 2023, the government has given approval to 45 companies/JVs operating in the defence sector with foreign OEMs.

Some examples of partnerships in Indian defence include:[4]

- Lockheed Martin with Tata Advanced Systems for C130 J and Sikorsky
- Boeing with HAL for the production of the AH64E Apache and CH-47F Chinook helicopters in India
- BAE Systems with HAL on the production of Hawk Advanced Jet Trainer Aircraft
- GE with HAL for GE 414 engine joint production

However, these are manufacturing JVs, with greater focus on integration, assembly and to some extent, licensed production, though an industrial base does get created in certain areas due to these JVs.

A JV in co-development has really not taken off, barring the BrahMos, which seemed to have been a special case between the Indian and Russian governments. The Indo-Israeli co-development programme on Long Range Surface-to-Air Missile (LRSAM) may also be taken as an example but it had a lion share of the development by Israel. However, a JV for development between a PSU and an Indian private company has not fructified so far and perhaps the time is ripe for this kind of consortium to be launched.

A Model for Future Development

Why MoD/GoI has discouraged JVs since the first BrahMos set-up—the reasons and constraints for this will need a separate discussion. However, based on all the past dealings and with the government stress on bringing private industries into defence, it is worthwhile to debate on the merits of establishing *a body that has the flavour and ethos of a private sector multinational corporation combined with the experience and resources of MoD agencies*.

Based on the above analysis and discussions, a suggested model for future development is outlined below.

The JV/Special Purpose Vehicle (SPV) model

Set up a JV/SPV with DRDO and a public and a private company with funding by each to the tune of 60/20/20 for system development only. Shared funding alone will enable true stake-holding among the concerned parties. The funding share by the public and private industry should focus on the establishment of production infrastructure at their premises to make them production ready in parallel. However, the cost of developing prototypes may need to continue to be borne by the government/MoD.

The role and responsibilities and suggested workshare of each should be as follows:

Services
QR formulation with Minimum Order Quantity (MOQ) and acceptance testing; QR should only detail performance requirements not specifications (based on global brochures as is sometimes the practice) of component sub-systems. Land for the final assembly/integration tests of protypes could be provided by users.

DRDO
DRDO to be the design authority. Personnel posted to the JV/SPV during the development phase should only be designers. There should be no Human Resources (HR)/administration/accounts personnel from MoD and these may be supplied by the private industry or hired on need basis.

DPSU
The responsibility for sub-system prototype manufacture should either be in-house or outsourced and should have integration responsibility for initial prototypes.

Private industry
Sub-system manufacturing and establishment of integration facility for follow on prototypes, which can be extended thereafter for production units. The private industry's share of funding should be utilised for setting up its own assembly/integration facility (under the guidance of a PSU) so that at least two parallel facilities are made available, one in a PSU and the other in the private industry for future orders.

A steering committee should be set up with members consisting of the senior-most management of each agency including the Services with the stated role to resolve issues and not just ask questions. Ideally, this committee should consist of heads of each agency and MoD finance. The steering committee should monitor overall technical progress with reference to plan, funds spent/committed; intercede in inter-agency issues that need resolution. The steering committee should meet at least every six months on a pre-fixed date not changeable by any member. This is another cause of delay and hence should be pre-fixed as the committee may need to ratify decisions, which will be on hold otherwise.

Human Resource

Personnel posted to the JV from MoD for the duration of the project should be allowed to draw deputation allowance. Only relevant HR to be posted as per stake-holding work share. Incentive to be given for timely completion with withdrawal/decline in deputation allowance if time exceeds.

Production order should be placed on JV after successful acceptance test as per pre-approved Authorised Training Partners (ATP)/qualification test schedule, which should detail the acceptance criteria. At that stage DRDO/ Services manpower to be downsized, public/private HR to be transformed for production.

The JV should be set up after the finalisation of QRs and quantity requirement and after the preliminary design is completed and reviewed by a High-Level Expert Committee (HLEC). Given the recent sanction of the AMCA programme with design documentation completed based on IAF QR, and HAL earmarked as public industry, there is a need to establish the JV/SPV with the private industry within a time period of six months and not draw it through protracted processes.

The CEO of the JV/SPV should be a private industry veteran not from the government (retired or otherwise) with full administration and financial powers. This is being suggested to begin the process of setting up a full-fledged MNC in due course on the lines of Raytheon/Lockheed Martin. Guidelines on contracting out tenders can be finalised during JV setting up and should ideally be as per private sector norms. It is to be noted that contracting and file processing is a major cause of delay in government-funded projects and hence needs to be streamlined.

Above all, the JV must operate like a private sector MNC with higher pay package, deadlines, incentives and penalties.

This model should be immediately taken up for AMCA and aero engines with an Indian private industry for AMCA and foreign private industry for aero engines.

Other Related Issues

Need for augmenting and training of aeronautics design engineers

If a country is to be a technology leader, there must be an ever-present pool of design engineers. There is a critical need for augmenting aeronautics design manpower base with sustained induction annually at major organisations such as National Aerospace Laboratory (NAL), DRDO aero centres—ADA,

GTRE. The government had more or less frozen recruitment in major R&D government organisations but this is detrimental to the overall technology progress of the country and should be resumed aggressively at least until the Indian private industry's HR rises to an acceptable level both in quality and quantity. Another area that requires continuous focus is training for skill augmentation. Aeronautics such as electronics is an area that is continuously evolving and hence it is essential to get quality manpower by training them at the best institutes worldwide. Government policies need to be liberalised for this purpose.

Need for creating a self-sustaining R&D ecosystem with academia and government institutions with liberalised procedures

DRDO has already made headway in this regard with a number of Centres of Excellence set up. But these need to be made more relevant with clear tie-ups with future projects so that the pool of scientific acumen never dries up. The system of DRDO–Industry–Academia Centres of Excellence (DIA–CoE) has now been streamlined and it is important for these to work on cutting-edge technology in aeronautics in areas such as stealth materials, morphing technologies, Artificial Intelligence (AI) and autonomous systems, for which a beginning has already been made.

Need for the Defence Services to take a more proactive and positive approach towards indigenous development

Ultimately the Services are the main players who will exploit the systems developed. So, their continuous involvement right from the design stage is essential, not just as an oversight body but as a positive influence on designers, sharing their valuable insights of desired performance. The earlier system of secondment of serving defence officers, which had been withdrawn for some nebulous reasons, may need a review as they served a very useful purpose of bringing in users directly into the project. However, users also must continue to treat them as their arm in DRDO and not ignore their inputs.

Conclusion

In summary, the time has come for pathbreaking measures to be instituted. We need to understand that a quality product cannot be developed in a timely manner at minimum cost, following convoluted government procedures. The entire machinery starting from user reluctance, delayed technology development, longwinded processes and regulations, a hesitant

public sector and a needy private sector capped at the top by slow and long-drawn government approvals—must all be reviewed to put in place an agile system aimed solely and wholly at delivering a quality product at an optimum cost in a timely manner to the armed forces, through an empowered team with full authority to deliver.

Notes

1. 'Boeing X-32', available at https://en.wikipedia.org/wiki/Boeing_X-32; 'Lockheed Martin F-35 Lightning II development', available at https://en.wikipedia.org/wiki/Lockheed_Martin_F-35_Lightning_II_development-.
2. 'Eurofighter Typhoon', available at https://en.wikipedia.org/wiki/Eurofighter_Typhoon.
3. 'Joint Ventures to Build National Defence Industries – Beyond Offsets', *Strategy &*, available at https://www.strategyand.pwc.com/m1/en/reports/2020/joint-ventures-to-build-national-defence-industries/joint-ventures-to-build-national-defence-industry.pdf.
4. 'Enhancing the US-India Collaborative Landscape in Artificial Intelligence', AMCHAN India, available at https://amchamindia.com/wp-content/uploads/2023/10/U.S.-India-Defense-Partnership.pdf.