ORF ISSUE BRIEF

SEPTEMBER 2015 ISSUE BRIEF # 105

The Advanced Medium Combat Aircraft: A Technical Analysis

Abhijit Iyer-Mitra and Pushan Das

Introduction

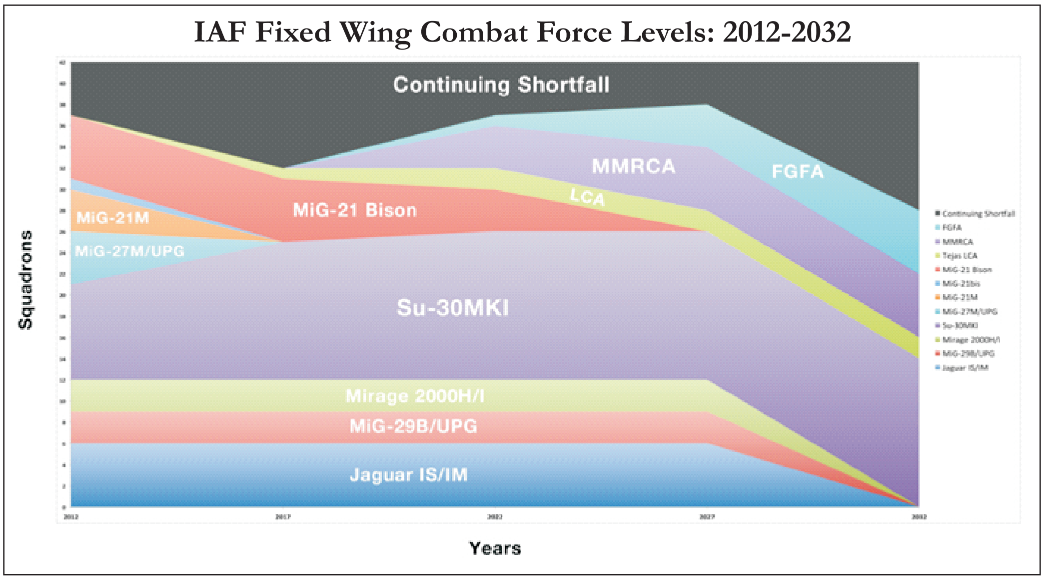
The Indian Air Force's global tender to buy 126 Medium Multi-Role Combat Aircraft (MMRCA) has been cancelled[1] and instead, a limited purchase of 36 Dassault Rafales is being negotiated without the transfer of technology[2] and local production envisaged in the original tender.[3] Meanwhile, the fighter strength of the Indian Air Force (IAF) is diminishing rapidly due to obsolescence.[4] The IAF operates a wide variety of aircraft which significantly complicates its logistics, training, budgets, and force synergy. The acquisition of just two squadrons of Rafales is hardly enough to overcome the numbers crunch.

The Aeronautical Development Agency (ADA), an aviation research arm of the Defence Ministry, however, believes its Advanced Medium Combat Aircraft (AMCA) may just be the answer that the IAF is looking for. The AMCA programme, though still in its design and development phase, is believed by the ADA to hold immense potential to replace a wide range of IAF aircraft while bringing quantum changes to fielded capability as the aircraft will be a generation ahead of what the IAF currently fields, or is considering. The indigenous Light Combat Aircraft (LCA), which the ADA has been developing over the last 30-odd years, has created an aeronautic ecosystem for the AMCA programme. ADA officials believe that if the IAF were to throw its weight behind the AMCA programme, it would result in a shift from short-term tactical thinking to a more long-term strategic view, keeping pace with technological developments and meeting future threats.

This Brief examines the AMCA programme, aggregating and comparing official information on the programme with its peers, and analyses the drivers of – and obstacles to – the successful completion of the AMCA project.

IAF Combat Fleet Forecast

Figure 1:



Source: Pushpindar Singh

Figure 1 is based on data collated from official statements on the phasing out of old aircraft and introduction of extant and new combat aircraft in the IAF. Even without analysing the feasibility of this induction-retirement schedule, some points stand out clearly. The first is that the venerable Mig-21 will continue to serve the Indian Air Force well into the 2020s – marking close to 60 years of service for this aircraft family. Second, specialist aircraft like the Jaguar (optimised for ground strikes) and the air superiority Mig-29 will continue to play a significant role in the IAF till at least 2032, with their phased retirement beginning only in 2027.

The graph also indicates that the number of fighters is expected to remain well below the authorised total, even assuming that the government procures another fighter in lieu of the scrapped MMRCA programme. This is subject to further variability should the negotiations for 36 Rafales fail and should the contract for Fifth Generation Fighter Aircraft (FGFA) being developed with Russia be cancelled, as seems likely. However, it is important not to assume that falling numbers automatically translates to a drop in overall combat capability or effectiveness. In this age of air-to-air combat beyond the visual range, standoff precision strikes and multiple targets per plane per sortie (as opposed to multiple sorties per target a few decades back) mean that a numeric shortfall does not necessarily result in a deficiency in capabilities.

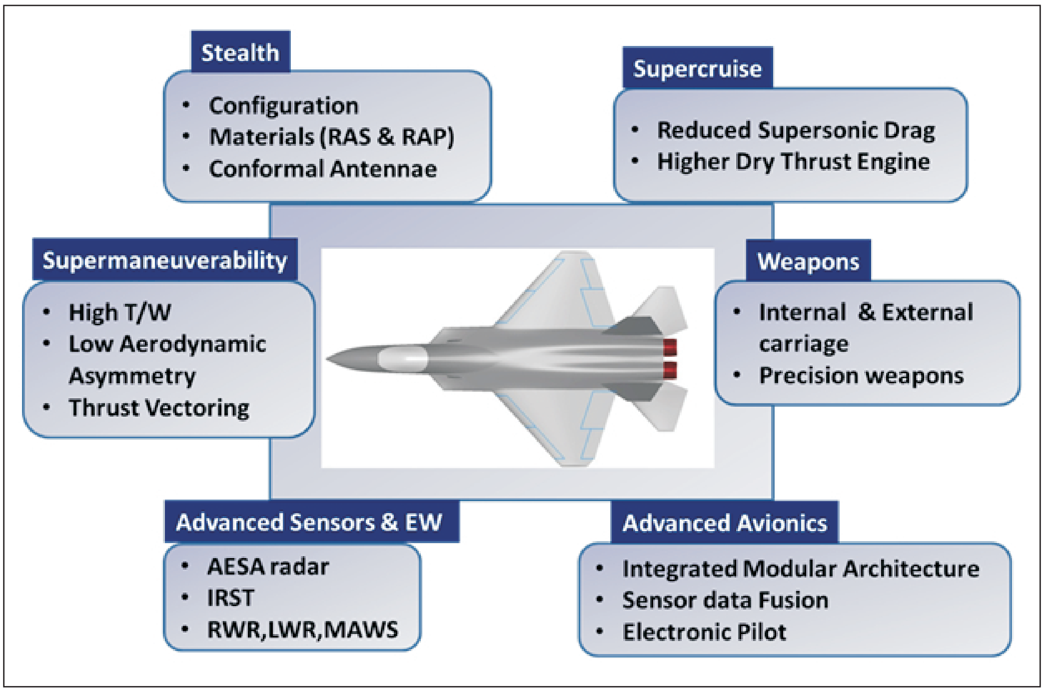
Yet the most striking revelation from Figure 1 is that by 2027, the Air Force intends to have a fleet almost exclusively comprising twin engine fighters. While such a trend is already beginning to show, it will sharpen considerably after 2027 following the retirement of the MiG-21 and the Mirage 2000. The MMRCA and Sukhoi-30 MKI will form the bulk of the IAF fleet. This means that contrary to international trends where countries have more light fighters and fewer high-end heavy fighters, the IAF arsenal will be almost completely dominated by twin engines heavies, with their attendant life cycle and operational costs. This raises several questions on IAF thinking of the High-Low mix, or even the High-Medium-Low mix despite the sheer nebulousness of the term 'medium' in IAF literature.

Figure 2:

Source: ADA

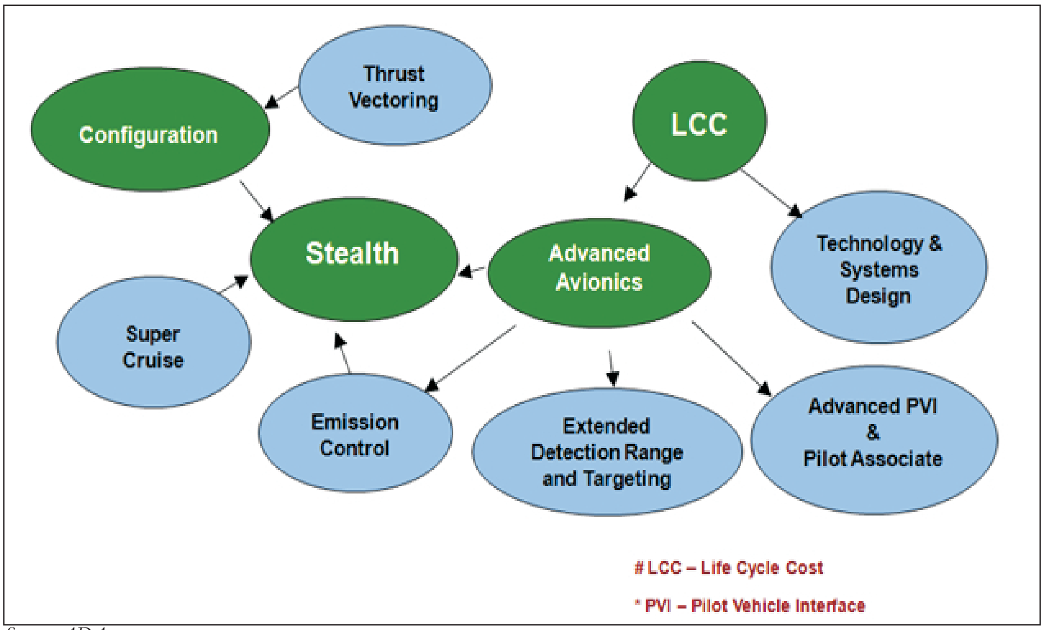
AMCA Design Drivers

Figure 3:



Source: ADA

Figure 4:



Source: ADA

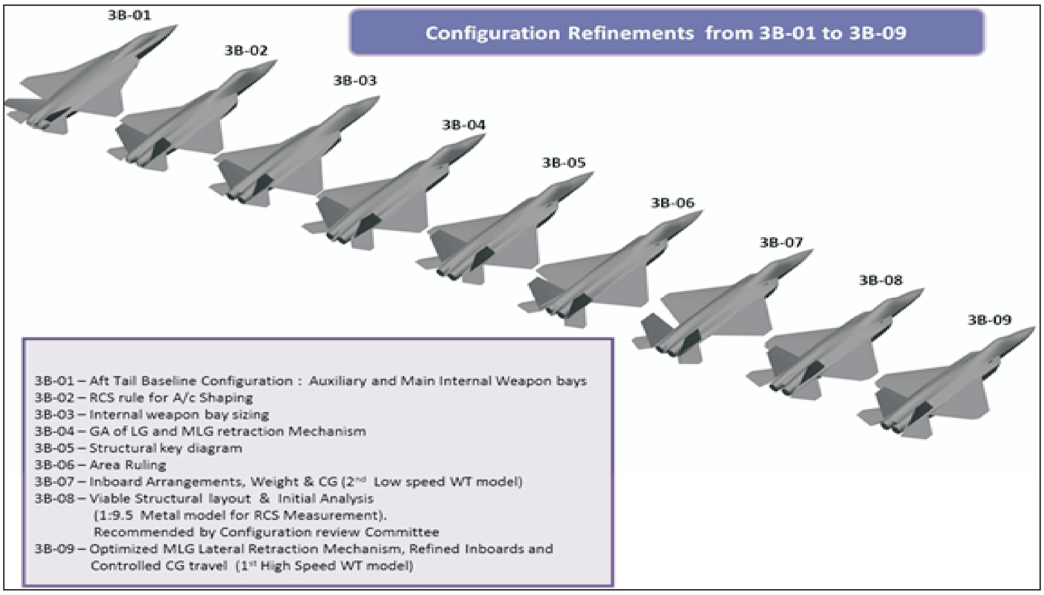
The AMCA programme is envisaged as replacement for a host of aircraft currently operated by the IAF as well as to fill gaps left by retirement of the Dassault Mirage 2000s, SEPECAT Jaguars and Mig-27s. The ADA has received definitive design drivers for the AMCA after the issuing of the Air Staff Requirements (ASR) in 2010.

The broad requirements outlined for the AMCA are to incorporate a high degree of stealth, a high internal and external weapons payload, high internal fuel capacity, and the ability to swing from an air-to-air role to air-to-ground. It is also expected to have the ability to super cruise. This allows the aircraft to travel at supersonic speeds with greater endurance as the afterburners do not have to be used with the additional fuel usage. Even though future air combat has been envisaged as being beyond visual range excluding the likelihood of aerial dogfights as before, the AMCA is expected to sport a thrust vectoring engine which will give it superior manoeuvrability in the event of a dogfight. The ADA is designing the AMCA as a platform with high survivability, to meet the challenges of future air defence environments through a combination of moderate stealth, electronic warfare capability, sensors and kinetic performance, including possible super-manoeuvrability. The design philosophy seeks to balance aerodynamics and stealth capabilities.

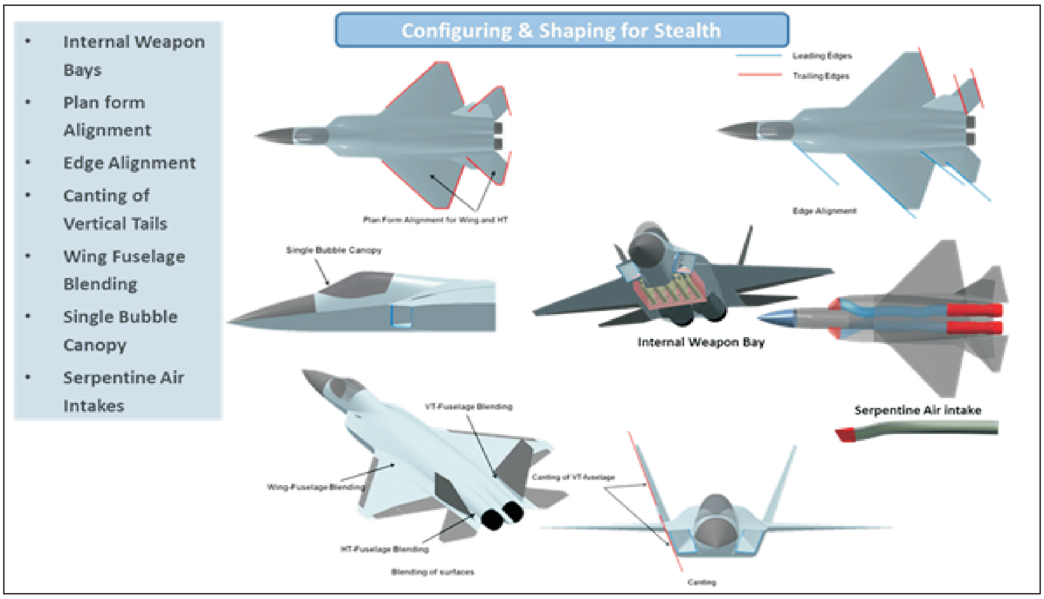
Design

The structural layout of the aircraft incorporates some of the key design features that define a 5th-generation fighter aircraft. The following graphics show the evolution of the AMCA design, and is consistent with the modifications to that design over the years. The initial tailless double engine, delta design is clearly no longer in the offing, having moved to a double delta wing, with vertical and horizontal stabilisers in design 38-01. By 38-09 the angle of the vertical stabilisers has changed and the wings too have transitioned to a design much like the F-22.

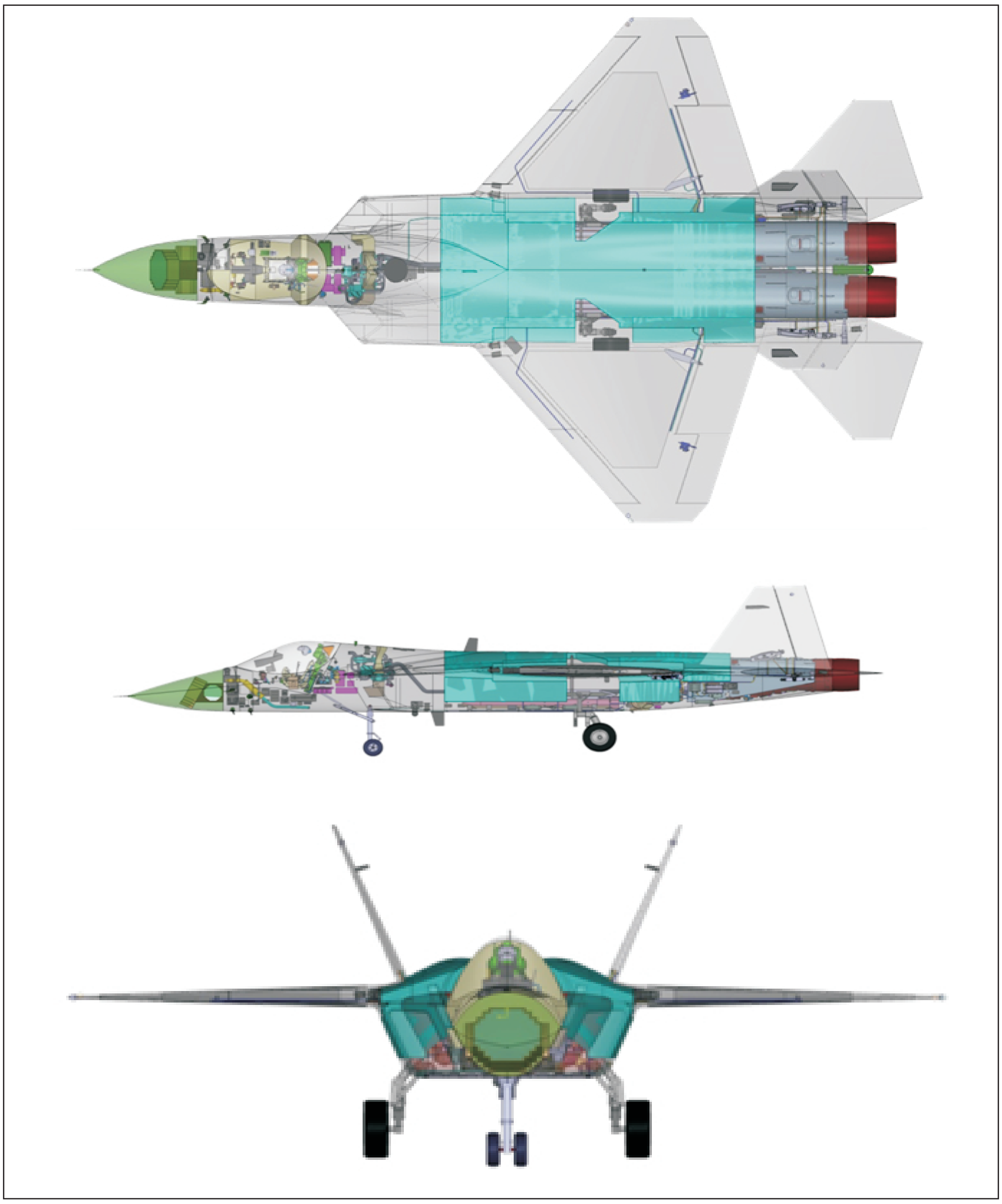
SOURCE: *defenceblog-njs.blogspot.com*



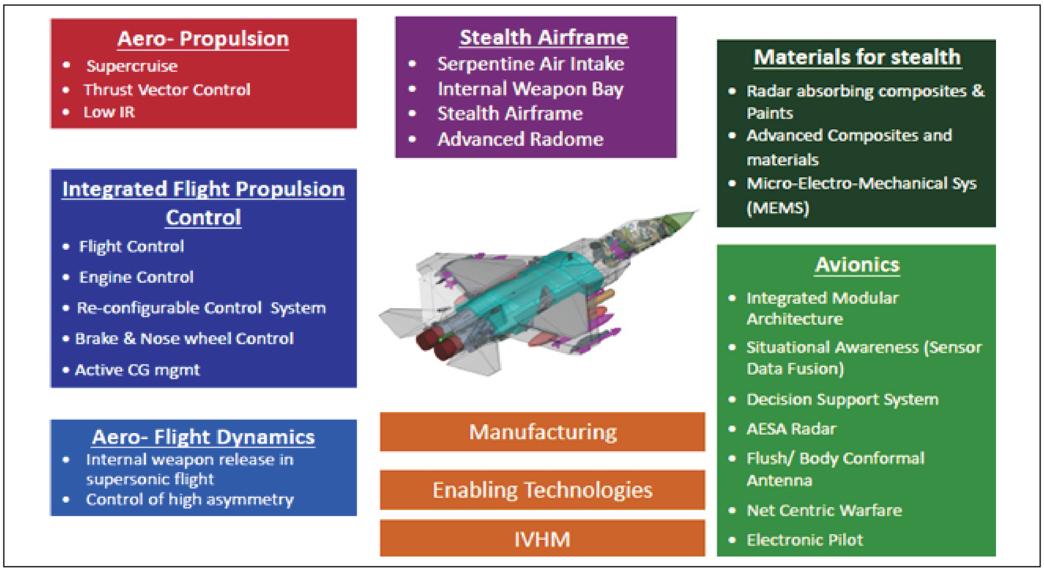
SOURCE: ADA



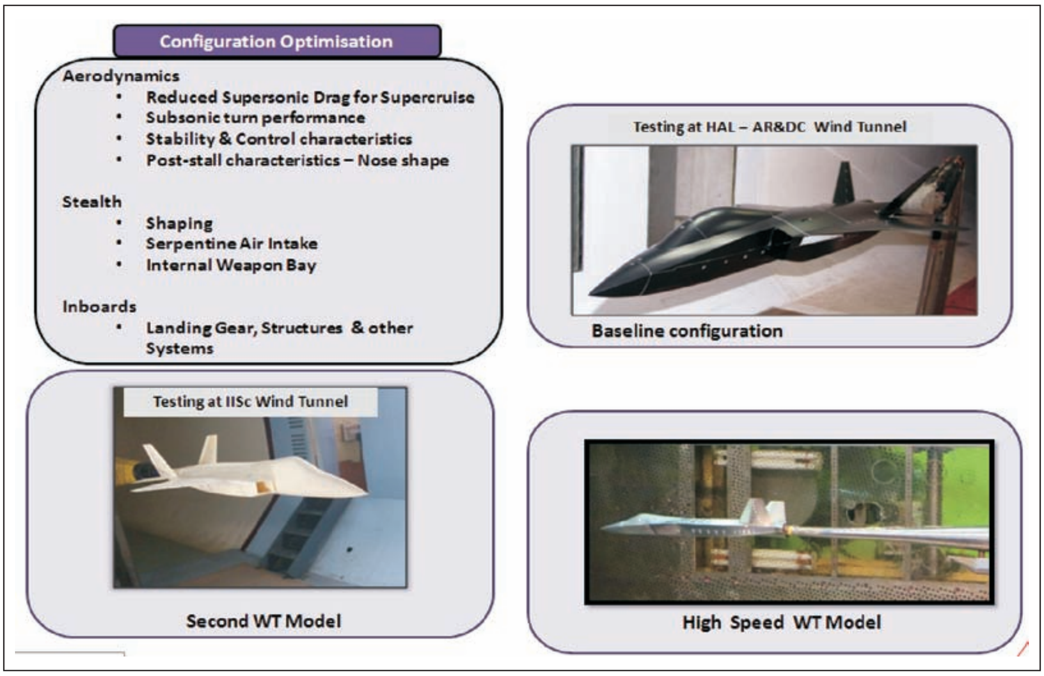
SOURCE: ADA



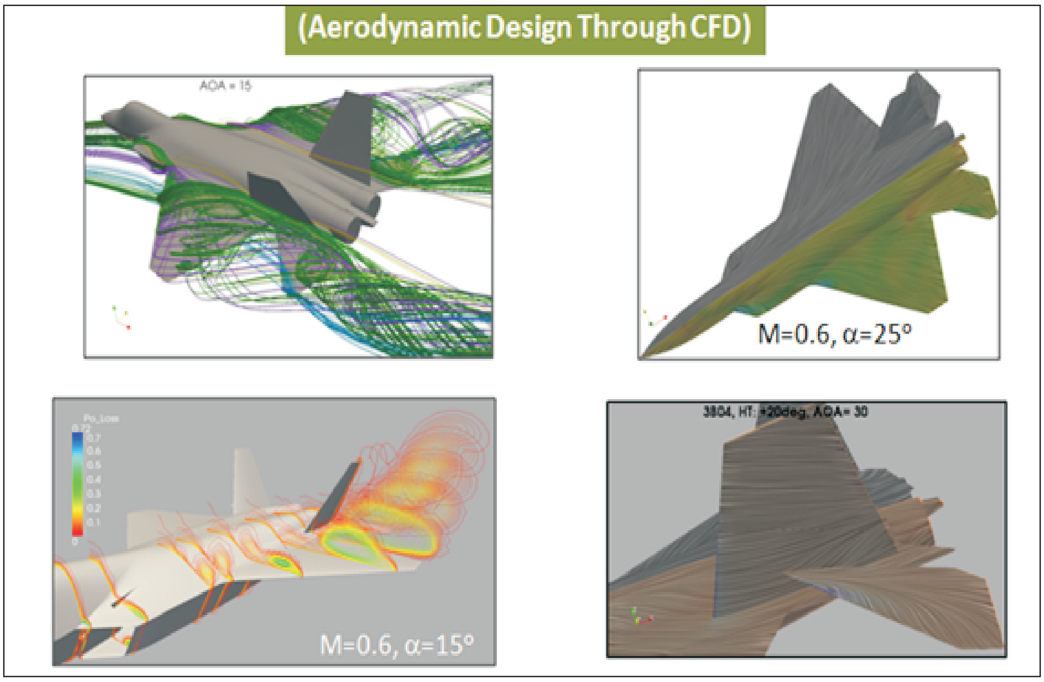
SOURCE: ADA



SOURCE: ADA



SOURCE: ADA



SOURCE: ADA

Front Aspect Stealth

The following section describes the AMCA's design, much of which seem to follow that of F-22, albeit with some significant variations. The front end—comprising the cockpit and radome as well as the air intakes—seems much closer to the X-36 unmanned demonstrator pictured, than to the F-22. That apart, from all aspects, the design shows significantly greater adherence to stealth principles than the beleaguered PAK-FA project – supposedly a collaboration between India and the Sukhoi design bureau. If the current graphics translate accurately into the production design of the aircraft, a high level of stealth can be expected from it against radars operating in the L band. X to C band stealth,[5] however, will be heavily dependent of the quality of construction, the shaping of the facets and joints, and of the equipment and weapons bay doors.

The exact nature of the skin's radar absorbency has not been discussed in publicly available material. It is safe to assume this will be in the nature of a Radar Absorbent Material (RAM) coating – possibly paint rather than the integrated RAM treatment cured into the F-35 panels.[6] The kind of treatment that will be applied to the joints remains unclear, though there is the possibility of using the maintenance-intensive 'adhesive strips' of the B-2 and F-22.[7]

SOURCE: NASA

SOURCE: NASA

Front Aspect Stealth and Engine Masking

Engines due to their large, highly radar reflecting moving parts are critical to any 'stealth' design. From a purely radar detection point of view, masking the engine intakes is critical – that is to say, no element of the engine should be visible when looking into the intakes. As a rule of thumb – if the naked eye can see the engine blades from the air intakes, then so can a radar. While several 4th-generation aircraft mask their engines partially by 'twisting' the air intake, true stealth needs complete masking that requires the engine to have an 's curve'.

The ADA indicates just such an S curve for the AMCA. This is achieved in two ways: with the internal weapons bay, and cockpit placed in front of the engines. This creates partial vertical masking. Partial horizontal masking is achieved by offsetting the alignment of air intakes. Theoretically, between the partial vertical and horizontal masking, the engines blades are fully concealed in the front hemisphere. However, since the official renderings of the ADA are not scaled and show an ongoing process, the extent of masking of the engine remains unclear.

The F-18, for example, has a partially offset engine and requires the addition of an inlet blocker to mask the engine.

SOURCE: photographyobsession.co.uk and f16.net

The Sukhoi PAK-FA, which has a distinctly more serpentine duct with significantly more offset engines than the F-18, has a vertical S curve which still does not manage to mask the engines completely and thus requires an inlet blocker, similar to the F-18. This is a cautionary tale for the ADA on the pitfalls of bad design, given that the PAK-FA is a bigger aircraft that should have been able to achieve better masking than the F-18.

SOURCE: A &B f16.net

SOURCE: bharatrakshak.com

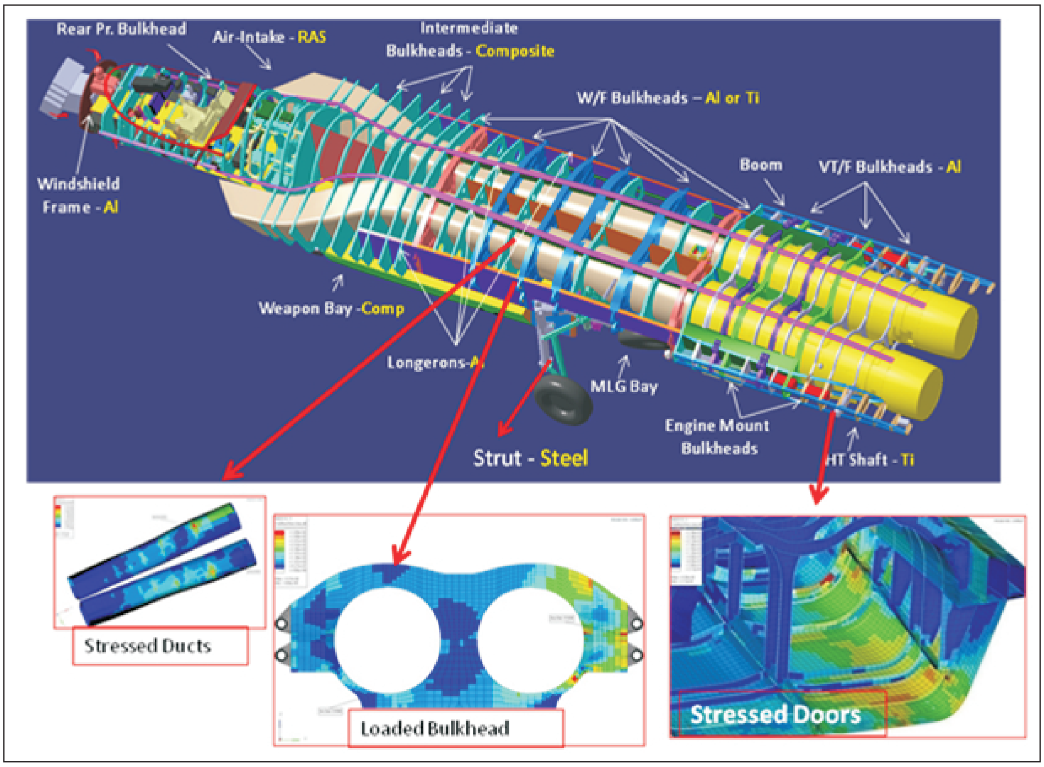
The AMCA design indicates a broad central internal weapons storage space just aft of the cockpit and air intakes. While one can speculate that this, combined with the vertical S curve could mask the engine entirely, it is impossible to tell at this stage, given that the dimensions of the engine remain unknown and hence its volumetric and alignment implications, unclear. Moreover, the F-22 is a large, heavy fighter with much space for expansive configurations. It remains to be seen whether such a configuration will suit a more compact, lighter 'medium' fighter that the AMCA claims to be.

It is to be noted that official renders mostly show the internal carriage of air-to-air weapons, possibly a conscious compromise given the volumetric restrictions of the design, unless India develops a munitions device similar to the Small Diameter Bomb (SDB) or obtains US variants for integration into the AMCA.

The following image of what is believed to be the F-22's intake duct shows clearly how serpentine these can be owing to the placement of the weapons bay and the offset of the air intakes. The pictures of the open weapons bays and their relative positioning to the engines and the air intakes clearly mask the engines completely as can be seen from the frontal shot of the F-22 air intakes where no engine blades are visible.

SOURCE: Defenceforumindia.com &Scott Dunham

SOURCE: AFWing.com



SOURCE: ADA

The ADA claims the radome of the AMCA will be of 'advanced construction', presumably meaning that it will only allow the operating frequencies of the mated radar to transmit from the dome, while blocking other radars. This is a significant stealth measure since normal radomes are merely shaped for aerodynamic efficiency but freely allow radar waves through. This means adversarial radar waves 'see' past the radome onto a flat heavily radar reflective surface. It remains to be seen if the radar will be bought from overseas or developed indigenously, given that the programme for the LCA's indigenous radar seems not to have yielded any visible results.

No mention has been made of similar radar evading transparent material for the cockpit canopy. The cockpit presents a problem similar to the radome. Shaped for vision and aerodynamic efficiency, the jagged edges and facets of the cockpit within reflect radar waves increasing its RCS. It remains to be seen if countries will be willing to share such highly sensitive cockpit canopy construction technologies.

Rear Aspect Stealth

Perhaps the most significant feature that detracts from stealth in these early design phases is the circular engine exhausts. These are not just radar reflective but also erode stealth in the infra-red and other electro-optical detection arenas. In contrast, square exhausts, as seen on the F-22, reduce infra-red signatures by up to 25 percent given the percentage increase in surface area of a square over a circle of the same dimensions. The exhausts of the YF-23 combined this approach of squaring out the exhausts with a long trailing 'canal' embedded with heat ablating tiles that absorbed some of the heat.[8] Cold air flowing over the top of the aircraft would combine with the hot exhaust in this pathway to further reduce the heat signature. From the side this pathway was shielded by the large tails, providing a significantly reduced heat signature across 270 degrees.

SOURCE: Airpowercallihan.cc &Northrop Grumman

Weapons and Weapons Bay

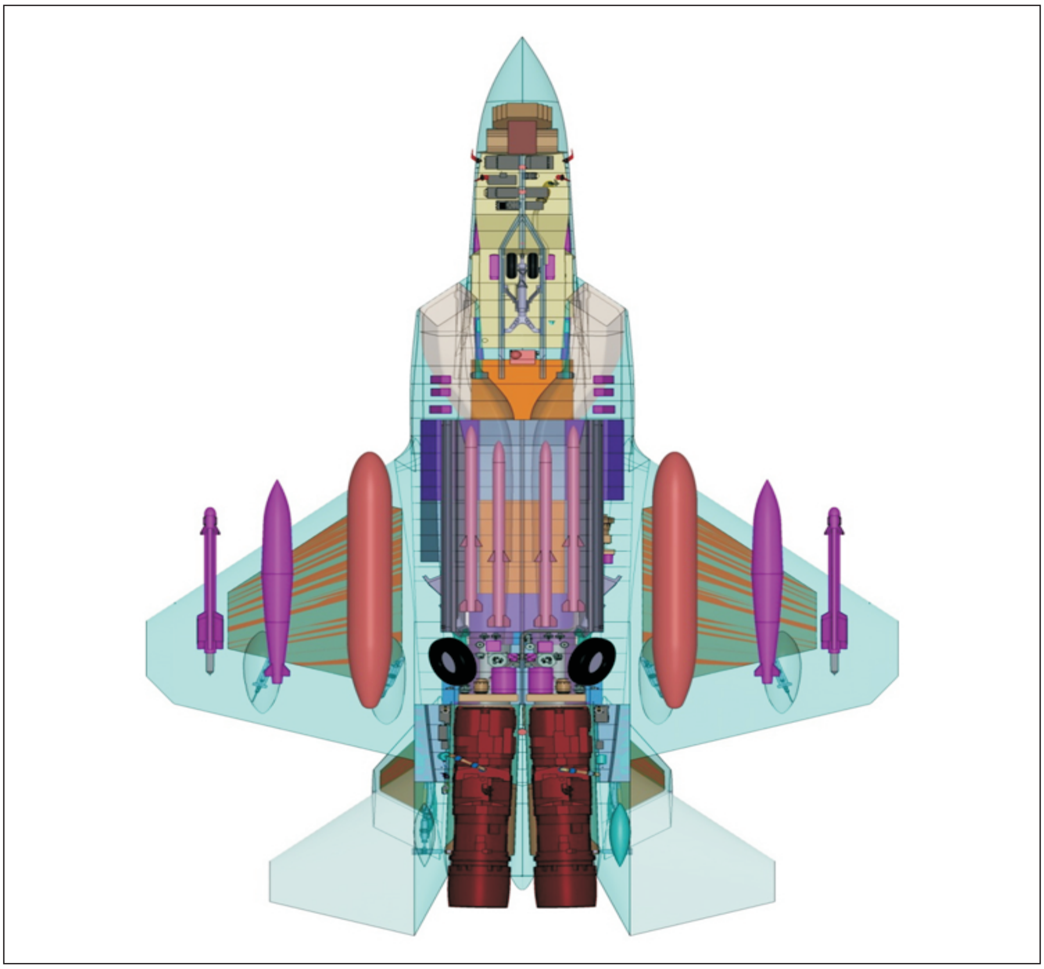
There seems to be lack of clarity on the size of the weapons bay. The illustrations shown in this paper variously indicate four or five air-to-air missiles that look exactly like the American AMRAAM. Some illustrations on the Livefist blog[9] – presumably official graphics – indicate the carriage of four Astra missiles which seem to have a much bigger diameter than the AMRAAM, compounded by the fact that they do not seem to have compact carriage folded fins – essential for the constraints of internal carriage. The quality of these images makes a closer analysis impossible, but some have pointed out that these graphics seem to indicate that the missile bears greater similarity to the Russian RVV-AE missile with its 'potato masher' tail finds folded for stealth carriage than it does to the Astra. This confusion regarding the existence of various graphics reveals one clear detail – that the Air Force has not settled on a choice of BVR missile or may not have communicated this to the ADA. The dangers of this indecision—whether unintended or deliberate (in order to keep all options open)—and its disproportionate impact on costs during the manufacturing and integration phase cannot be understated.

The graphics also seem to indicate two 500-kg indigenous Sudarshan Laser Guided Bombs. Though even here the shape of the bombs does not seem to fit any bomb currently in service or otherwise planned. This throws up serious questions on the exact parameters and dimensions of the weapons bay being designed. As will be discussed in latter parts of this paper, the lack of a conformal electro-optical targeting system may mean that even the laser-guided bomb is superfluous to the design and the aircraft may only be able to launch GPS guided munitions.

Other (possibly earlier) graphics show additional side weapons bays – smaller bays for dogfight missiles, exactly mimicking the configuration of the F-22's side bays. Such a large volumetric capacity would also seem to duplicate the F-22s weapons load of two 1,000 lbs guided Air-to-Ground munitions plus two BVR Air-to-Air missiles in the main bay in addition to two shorter range, aerial dogfight missiles in the side bay. The latest graphics, however, seem to have eliminated the side-weapons bays. There is also an inconsistency in the depth of the bays – the latest graphics demonstrating a load out of AMRAAMs which seem to indicate it is not deep enough to hold the much bigger Sudarshan Precision Guided Munitions (PGM).

Perhaps the biggest design challenge for the AMCA's weapons bays is the lack of a suite of indigenously produced weapons systems. As of now, the Beyond-Visual Range Air-to-Air missile (BVRAAM) Astra and PGM Sudarshan are in their test phases.[10] This means an optimal weapons bay size cannot be arrived at without significantly constraining the size of future weapons developed domestically. On the other hand this may, in fact, have significant positive effects on future weapons designs by volumetrically limiting their size and prioritising compactness and miniaturisation – though at a heavy cost.

The newer graphics also seem to show a single large bay with two bi-fold doors, as opposed to previous graphics that showed a middle ridge separating two distinct weapons bays. The implications for hull integrity, however, cannot be gauged till clearer, more advanced graphics become available.



SOURCE: ADA

Source: http://news-and-encyclopedia-update.blogspot.in/2012/04/malaysia-get-rvv-ae-air-to-air-missiles.html

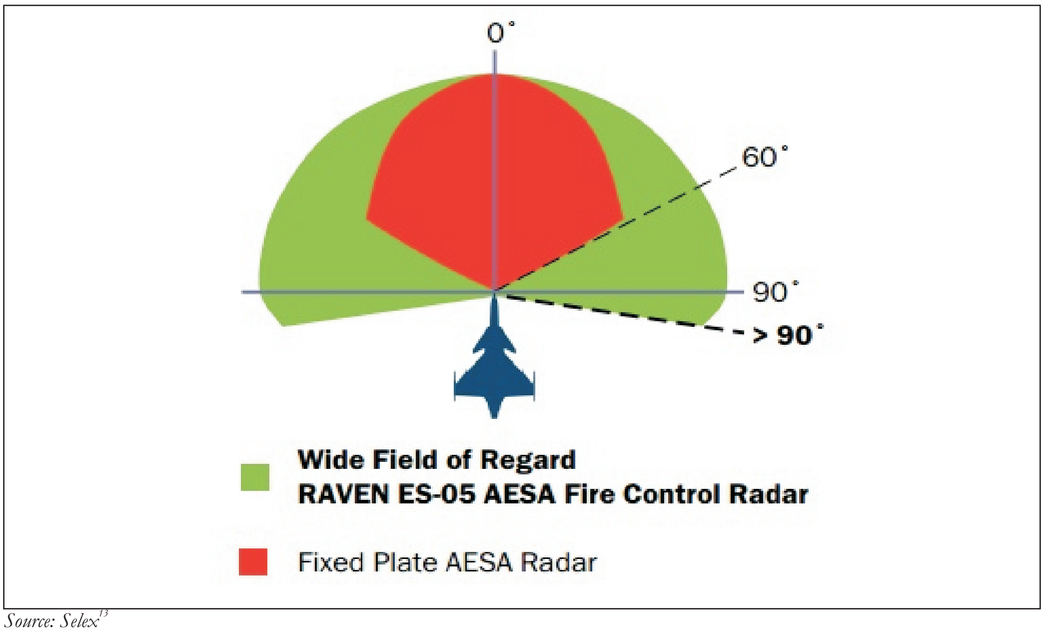
Source: The Economic Times and tarmak007.blogspot.com

Source: Ausairpower.net

Source: Ausairpower.net

Sensors and Targetting Systems

The AMCA will incorporate an Active Electronically Scanned Array (AESA) which, the official illustrations indicate, is also mechanically steerable like the CAPTOR-E of the Eurofighter[11] or the Raven ES-05 of the Gripen.[12] This explains the legacy 'bulge' of the radome – a flat antenna which increases the aircraft's Radar Cross-Section (RCS) – as opposed to the more vertically compressed radomes of the fixed array designs on the F-18 and F-22. This is an advantage as the beam manoeuvrability of an AESA can be stretched to a broader detection area.



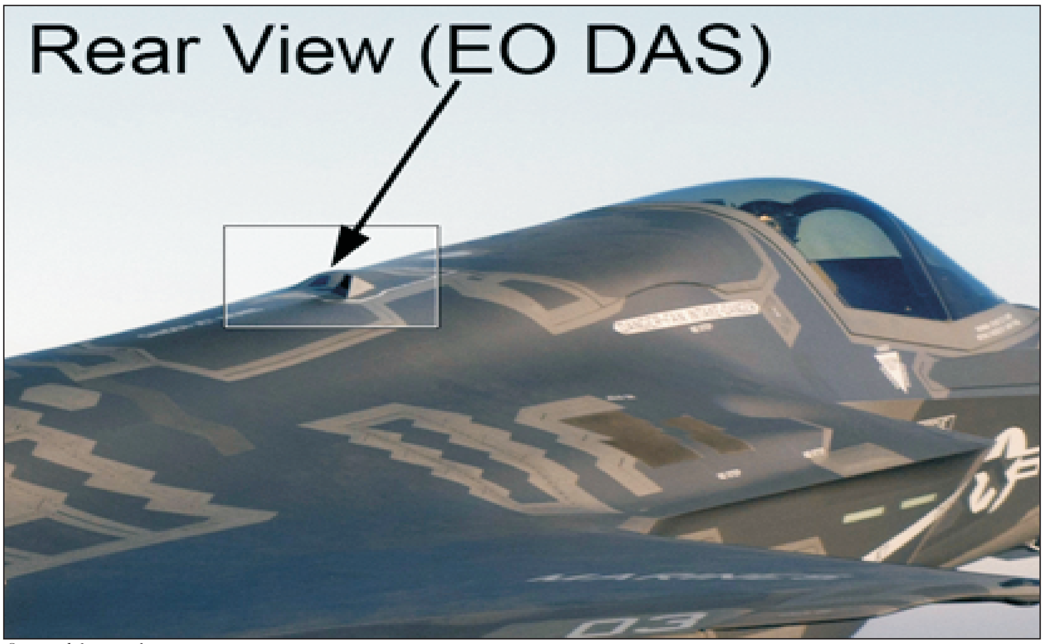
Source: Selex[13]

Current official graphics and statements indicate that the AMCA is expected to house most sensors conformally to maximise stealth. What cannot be discerned from these graphics is an optical or synthetic Infra-Red Track and Search (IRTS) system. While the ADA does indicate the plane will have an IRST, the renders do not show the legacy spherical IRST bulge that is highly radar reflective. The fact remains that no country outside the United States seems to have developed a conformal IR/Synthetic vision S&T and there will be significant developmental hurdles here. Given this single vendor situation for conformal IRSTs it seems highly unlikely that the AMCA will be cleared for technology transfers given that the F-35 would seem to compete in roughly the same space as the AMCA.

The AMCA also does not appear to have a conformal Electro-Optical Targeting System (EOTS). This means it will have limited ground strike capabilities – restricted to GPS-guided weapons only. This means both laser-guided weapons and optically guided weapons required for pin-point precision as well as the engagement of moving targets would not be available to the AMCA. In effect this would mean that it duplicates the role of the F-22, which is overwhelmingly an air superiority fighter with at best a secondary ground strike capability. Unlike the single vendor situation of the conformal IRST - the Russian MiG-35 seems to have a system similar to F-35's EOTS – the OLS-K (though once again its spherical shape means it is radar reflective). The OLS-K, like the F-35's EOTS, is constructed of artificial leuco-sapphire. Various attempts at tracking down local producers of leuco-sapphires for this paper yielded no results and possibly points to a local production deficit that will have to be overcome. Given the highly limited nature of the market, though, it might be impossible to create economically viable manufacturing facilities for leuco-sapphires in India.

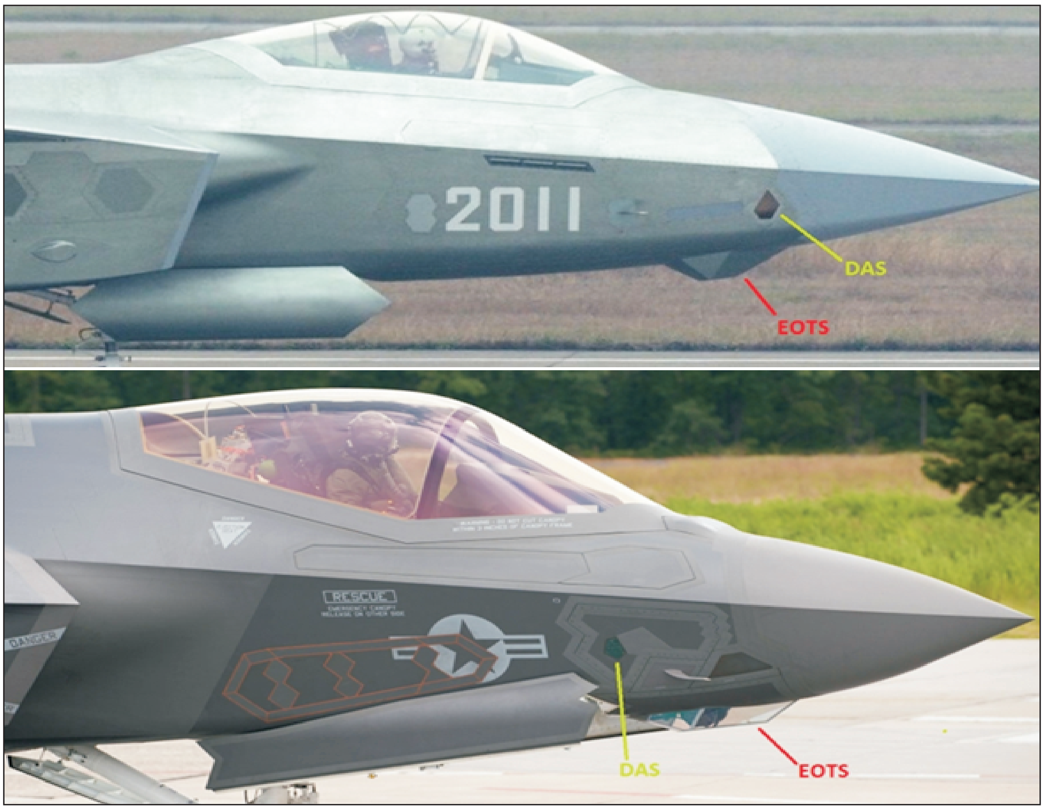
Source:qq.com

Source: United States Marine Corps



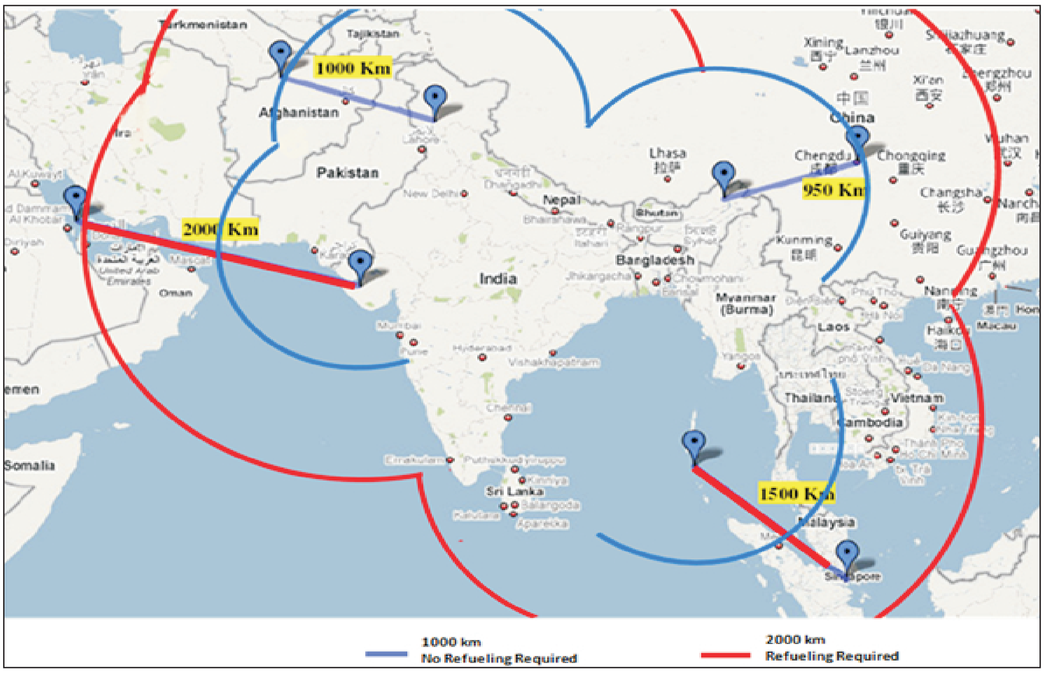
Source: defence-arab.com

It is to be noted that at least one prototype of the Chinese J-20 fighter has been spotted with equipment that resemble the F-35's EOTS and DAS. However, questions remain if these are functional equipment and in any event, the adversarial relations between India and China would preclude any possibility of Indian access to a Chinese vendor.



Source of both pictures : http://sandrermakoff.livejournal.com/574462.html

Range



SOURCE: ADA

The ADA is designing the AMCA with an internal fuel capacity of 4 tonnes to exclude the necessity of carrying outboard fuel tanks which significantly compromise the aircraft's stealth properties. The ADA estimates that the AMCA will have a combat radius of 1,000 km on these 4 tonnes of internal fuel. It will however be equipped with air-to-air refuelling capability, increasing its endurance and operational radius as can be seen in the range arcs provided above.

It must be noted that the F-35 A carries 8.3 tonnes of fuel and the F-35 C close to 9 tonnes that enable both these aircraft to achieve a combat radius of no more than 1,100 km for an aircraft with a maximum take-off weight (MTOW) of 31 tonnes.[14] It would seem therefore that the AMCA would have to be half the weight of the F-35 in order to achieve a 1,000-km unrefuelled combat radius or have revolutionary engines that cut fuel consumption in half.

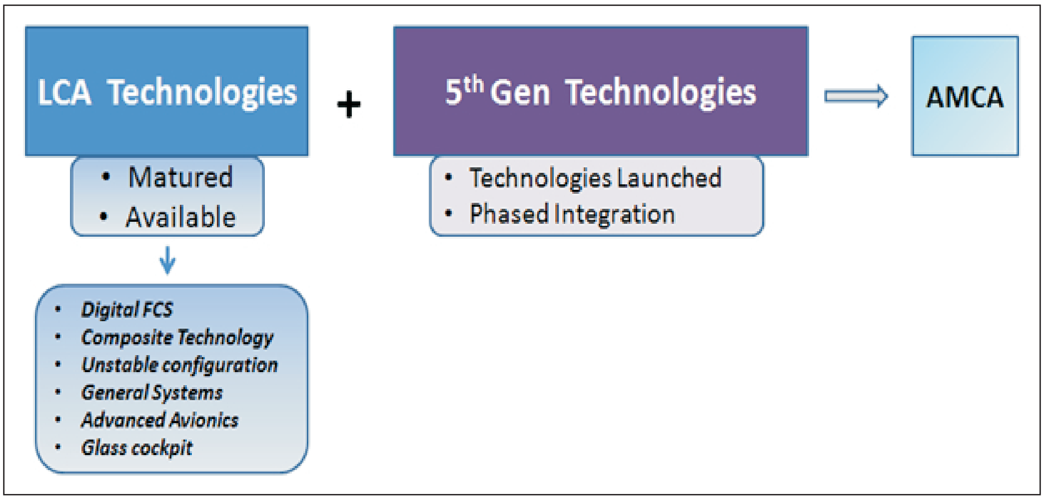
Given that the AMCA is a twin-engine aircraft with greater fuel consumption, such range statistics as given by the ADA simply do not hold up to preliminary scrutiny.

Leveraging the Developments from the LCA for the AMCA

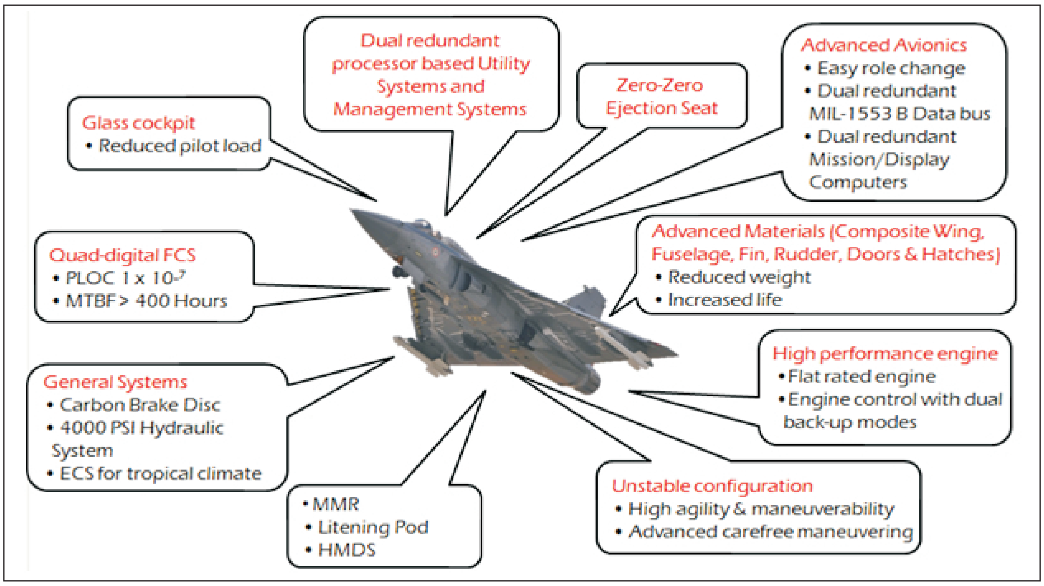
The AMCA programme (unlike the LCA which was a clean sheet experience) will be able to leverage the experience gained from the LCA programme over the years. When the LCA programme was sanctioned in the 1980s, India did not yet have the technical wherewithal to develop and build 4th-generation aircraft; it also had not even built a 3rd-generation fighter aircraft on its own. As a result, it went through a long-drawn development process, starting almost from scratch.

When the AMCA programme moves towards its first technology demonstrator, it will have access to a number of 4th-generation aircraft technologies that can be improved upon and used. Indigenous developments in composite technology, avionics, digital fly-by-wire flight control systems, glass cockpits which reduce pilot work load, and a host of homegrown weapons systems, have given the AMCA a base from where to start its development. India's failure in aero-engine development will see ADA tying up with a foreign vendor for the AMCA's engine requirments.

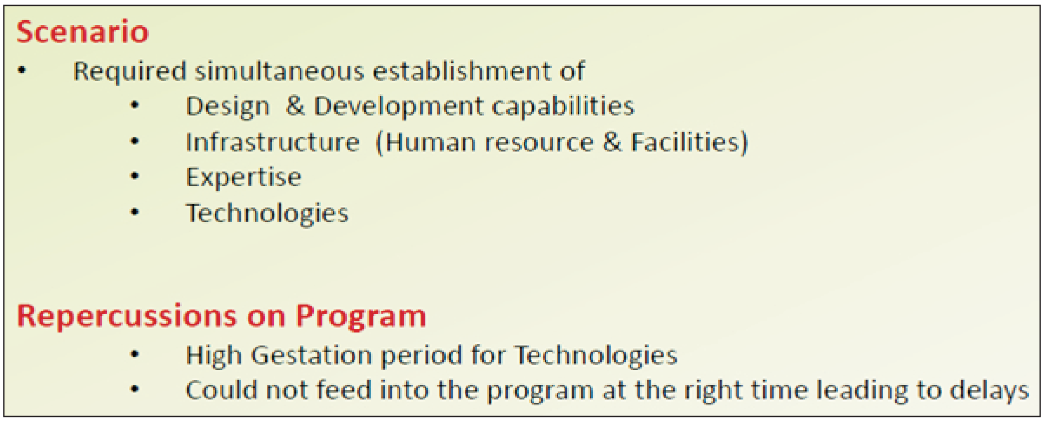
Figure 6:

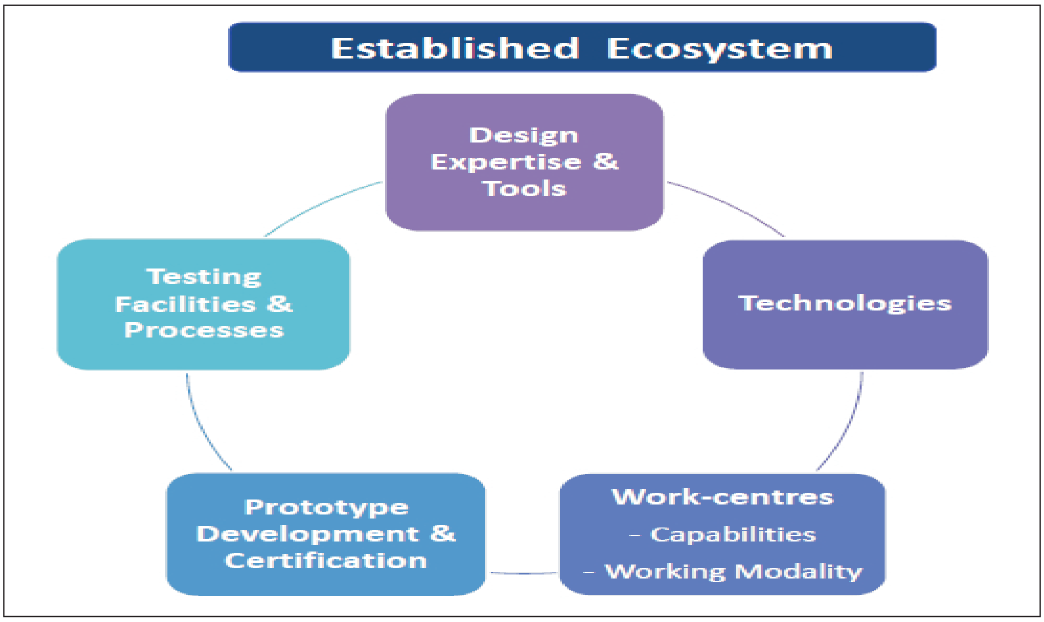


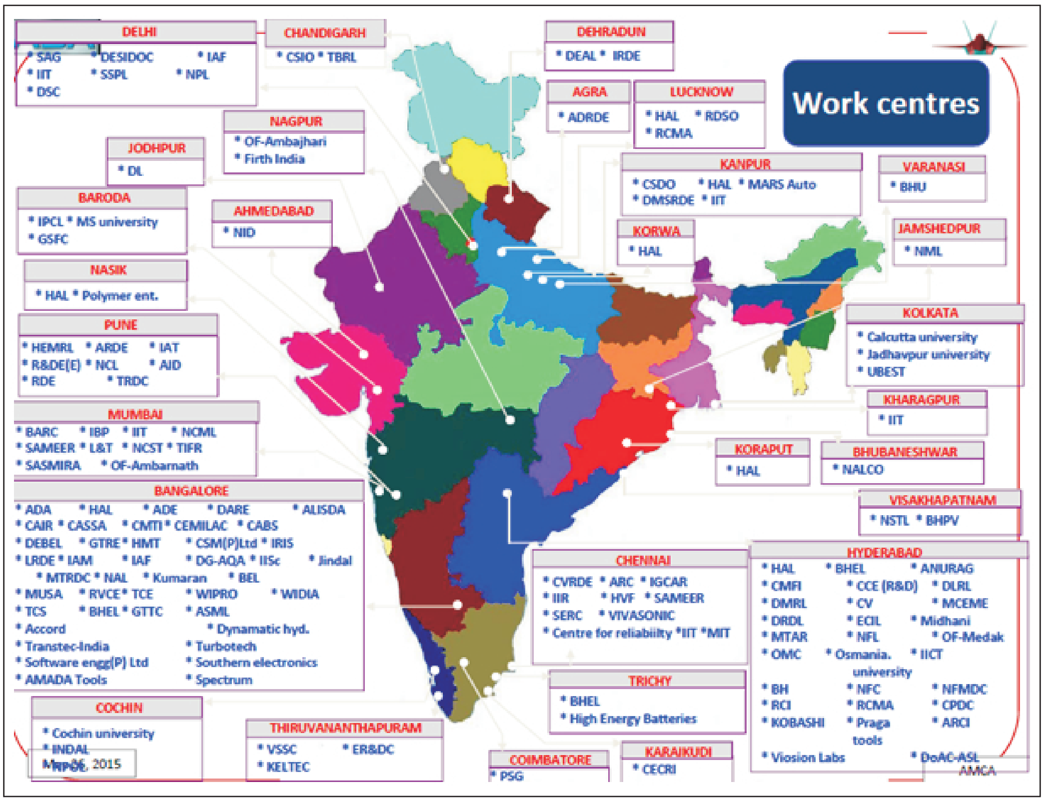
Experience Gained from Lca Programme



Lessons Learnt







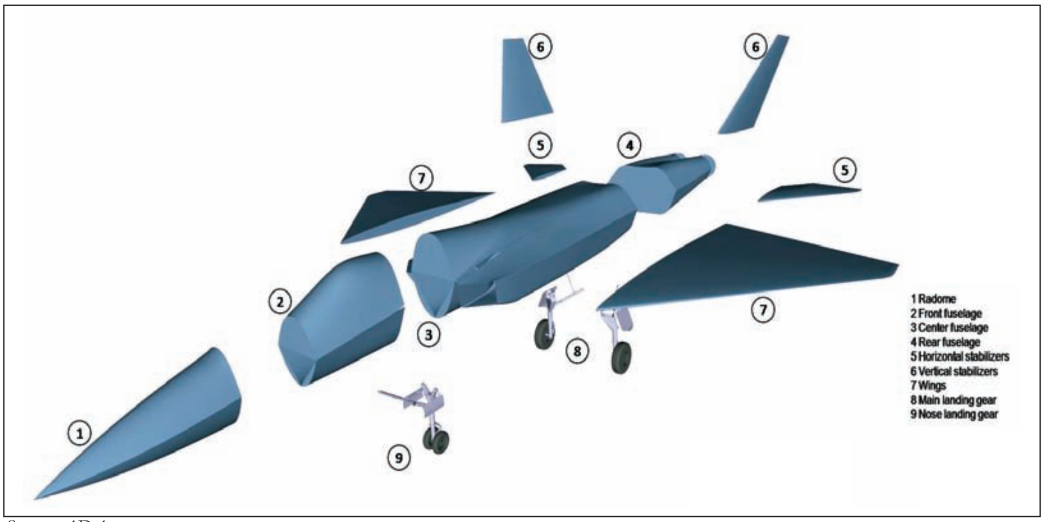
Source: ADA

AMCA Modular Design Approach

The AMCA programme faces a number of constraints, but the ADA has devised strategies to work around them. As the ADA realises, it is burdened with a number of aircraft programmes resulting in limits to available manpower and in-house resources. The expertise of private industry are expected to be leveraged to make up for in-house deficiencies.

The AMCA programme will make a clear break from the LCA programme in its development and production concepts. Not only will the private sector be a part of the development process, it will also be playing a major role in the production of the aircraft. The aircraft will be designed and divided into a number of major modules (See Figure 8); each module will be built and assembled independently, to be integrated by a lead integrator, which will be the state-owned Hindustan Aeronautics Limited (HAL). In a first, each module will be executed by select private companies. These modules will have their set standard operating procedures requiring testing and 'signing off' before delivery for final assembly.

Figure 8:

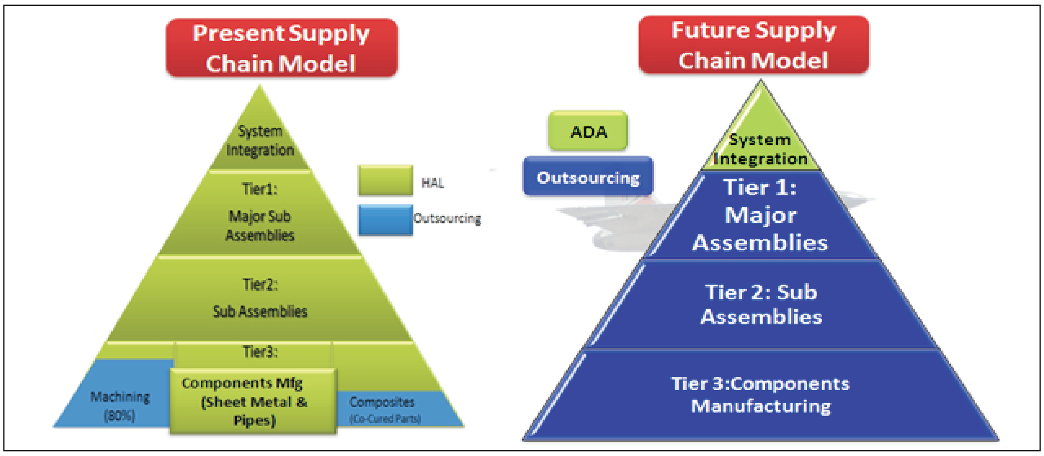


Source: ADA

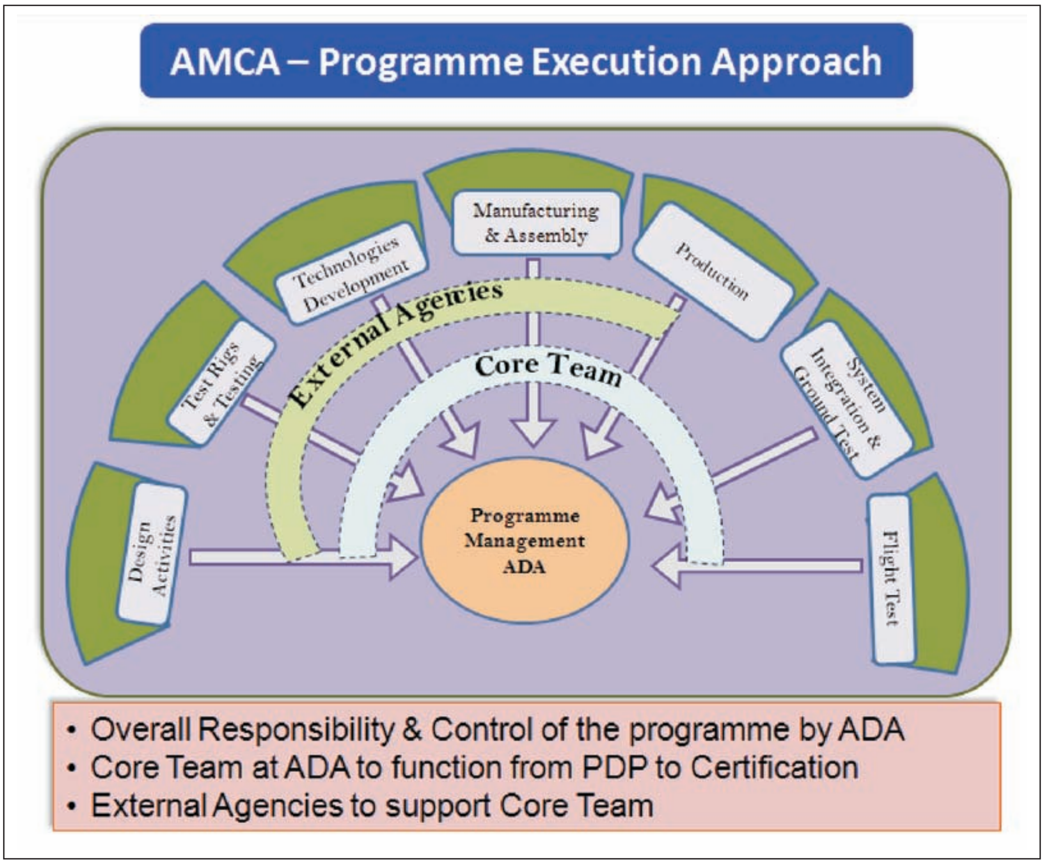
At present, HAL is the only company with the experience and technical capacity to play the role of lead integrator and has the infrastructure for flight testing and production certification in the country, however unsatisfactory its performance in the past has been. But given that the AMCA programme will take close to a decade before gearing up to full-scale production, the possibility of private players developing the technical wherewithal to play the role of lead systems integrator cannot be ruled out. The Tata Group and Reliance Industries are both in the process of forming collaborations with foreign companies to enter aircraft production. It is of utmost importance that the lead integrator with requisite infrastructure and expertise be identified early, if ADA plans to overhaul the current supply chain model in place.

The identified agency for integration will be involved in the design process early. ADA will create the framework for the outsourcing of modules and their integration. The selected agency will be responsible for companies constructing the different modules, which in turn will be responsible for outsourcing the sub-systems required for the module. Figure 9 shows the workload that the ADA expects to outsource when the AMCA hits the production line, compared to the current supply chain model in place for the HAL LCA.

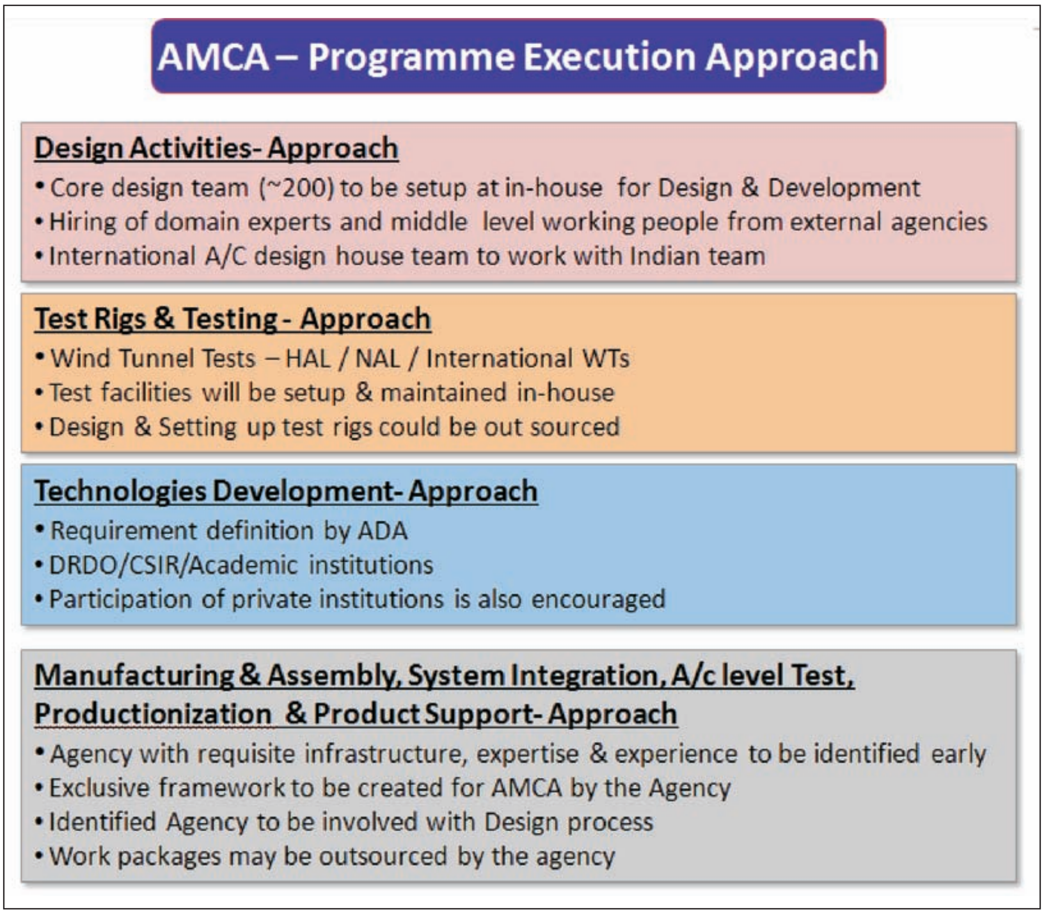
Figure 9:



Source: ADA



Source: ADA



Source: ADA

Conclusion

As has often been clarified by the ADA, the prime objective in the design phase remains the "creation of space". This means that given the restriction on weights and dimensions, the size of the weapons bay is to be optimised. At the same time, the sensors and stealth are stated by the ADA as the "prime drivers" of the design.

This seems to indicate an incomplete understanding of what it is that a 5th-generation fighter actually does – specifically the aspects of interoperability, sensor fusion, supporting other arms of the military and the ability to seamlessly share situational awareness with them. The fact that an F-22 layout has been chosen – one that requires space and weight – seems to overestimate India's ability to miniaturise, or severely underestimates the amount of equipment required to carry out true 5th-generation warfare.

On the other hand it does seem to have internalised one aspect of a 5th-generation fighter, namely, design stealth. This one aspect allows the aircraft to break the kill chain starting from detection by L Band radars to close engagement X band radars, although invisibility to the X band will be heavily dependent on joining and construction quality. This property allows a stealth fighter to carry out ground attacks and air superiority missions without having to worry about supressing enemy air defences (SEAD) first.

The problem is these two – systems bloat and stealth are in fact competing yet complementary demands – underestimating one can lead to compromising the other as has been seen with the F-35. There are festering problems of systems integration and subsystem volume and weight, among many others, in the IAF's fleet, as the F-35 has demonstrated. Largely because of these problems, a stop-gap measure has been adopted for the F-35s sensor fused helmet display, while weapons bays have been shrunk due to the volume of the sub-systems.[15] External faceting to maximise stealth has been significantly compromised, prompting several commentators to reclassify the fighter from very low observable (VLO) to merely the low observable (LO) category.[16]

In India's case the problem of integration with other assets is compounded because of several different national vendors using different standards. For example, the F-35 only has to communicate with NATO standard Link-16 equipment. The AMCA, given the military's consistent refusal to sign foundational agreements on communications and others with the United States means that the wonders of Link 16 will not be available to India. As a result, the AMCA will have to communicate with Russian systems, Indian systems and bespoke Israeli and French systems developed to overcome the lack of the Link 16. This means the interoperability "net centric" burden of the AMCA is in fact three to four times greater than that of the F-35.

It must be pointed out that there remains severe confusion regarding its 1,000-km unrefuelled combat radius on just four tonnes of fuel, the size of its weapons bays, and the consequent ability to both carry fuel internally and mask the engine blades effectively.

The lack of several core optical and electronic sub-systems manufacturers, production expertise, and end user knowledge and expertise are particularly worrying as many of the sub-systems will be produced and used for the first time in India. Consequently, the potential is immense for each of these to significantly add to time delays, late stage design modifications and the associated cost escalation. There are no proposals in the public domain for concrete risk-reduction measures. In that sense the concept of "creating space" loses its meaning unless the sub-systems bloat, and mass and volume increases of these sub-systems are not factored in.

Equally important is the lack of public discussion on expected operational and life cycle costs of this aircraft nor specifications from the air force as to the desired price range of such cycles. This leads to the core problem of what constitutes 'medium' in the Indian context. Is it a definition based on costs? Or is it either of weights, range, payload, or sensors? Given that Ministry of Defence representations to successive parliamentary standing committees on defence have variously blurred the definition of this aspect, we are yet to discern a single clear cost-benefit analysis in the Indian context of the weight-based categorisation of aircraft given the lack of any document that publicly states the desired effects. It should be noted that the "Low" end of the future USAF fleet – the F-35 seems to have the same range as the AMCA, and presumably a similar weight (32 tonnes).[17] If the weight increases to more than the F-35 then by India's own classification the AMCA would be a heavy fighter.[18] On the other hand, if the weight is to remain under 30 tonnes – the design features of a twin engine, 1,000-km range and a cavernous weapons bay, seem impossible to achieve.

It is telling that the question remains unanswered, even in private discussions of the desired effects the air force wants from its fleet, both in the context of the total fleet, and also specifically the AMCA. Clearly, the AMCA's design drivers have not been back-calculated based on effects which lead one to suspect that they are instead based on a 'cut and paste' job of shiny new technologies and designs on the block.

Importantly, while LO and VLO are just one aspect of a 5th-generation fighter, the most critical aspects are in fact sensor fusion, man-machine interface and the integration of the aircraft with other land, sea and air forces, and as part of a broader fleet of aircraft comprising a totality of air power. An elaboration of these aspects has been notably absent from the design phases.

While the move from being prime manufacturer to prime integrator of the AMCA is a laudable shift for the government, several lessons that have been learnt in the Sukhoi and LCA programmes seem to have been ignored. Primary amongst them is that India faces a shortfall not just in manufacturing but also in systems integration. Most manufacturers in fact consider systems integration to be the hardest and most expensive part of building a weapons system. To complicate matters, not a single Indian university offers a course in systems integration indicating a significant lack of domain knowledge.

Similarly, the openness to foreign manufacturers for local co-production is a laudable goal and indicates a shift in the right direction. The issue is that the ADA needs to be investing heavily in a legal team to lobby Parliament and policy-makers for changes to the Intellectual Property Rights (IPR) and

Investment laws, as the current laws would abort useful transfers of technology and processes from foreign manufacturers.

There are follow-on aspects to consider as well, including those related to industrialisation. A country that imports and industrialises such high-end technology needs to have broad spectrum amortisation plans to justify and make profitable technology absorption. A lack of such amortisation plans invariably leads to high degrees of scepticism and non-cooperation from the private sector. It would therefore be advisable to get into active consultation with the private sector at this stage for amortisation and spin-off feasibility to be understood and factored in. Unlike the HDW Type 1500 submarines, where India gained much manufacturing and process knowledge, which was lost after the last submarine was built, (due to a lack of follow on orders and the inability of a structurally constrained Mazagaon docks to diversify and spin off absorbed technologies) India must look towards innovative models such as those from Australia. The building of the Collins class submarines, for example, led to a subsequent migration of the highly skilled workforce on the submarines to the mining sector, after the completion of that programme, and resulted in the Australian mining revolution with innovative approaches to mineral extraction. The evolution of this highly skilled workforce and the flexibility of the Australian Ship building industry have meant that this same workforce can be brought back into the system for building the next generation of Australian warships: The Hobart Class Air Warfare Destroyers and the Canberra Class amphibious carrier.

Equally important given the level of customisation involved and the expected low production run, the economics of a stand-alone programme and the willingness of the private sector to invest in this must be examined closely at the embryonic stages. This will be impossible to do unless the private sector is asked to scout out the feasibility at an early stage in the process.

Recommendations

Given the above, it might be a good idea for the ADA to implement or consider the following before concrete proposals for funding are forwarded to the government.

1) Pinpoint the exact meaning of the term 'medium' in IAF thinking, including clear measures of ranges and payloads, and costs including the corresponding operational and lifecycle costs. This is critical since the F-35 experience shows that miniaturising and fitting volumetric and weight limits can be one of the most debilitating challenges of designing a modern fighter.

2) Commence intensive negotiations with the private sector for a joint proposal to the government on the following:

    a. A framework of investment and IPR laws to facilitate technology transfers specific to this programme.

    b. A comprehensive feasibility study on the absorbability, sustainability, profitability of technologies transferred.

c. A comprehensive survey of universities and institutions to understand where the knowledge deficits lie within the programme and to initiate courses in select universities to create a pool of knowhow that can absorb knowledge during the actual manufacturing and transfer phases.

3) Identification of manufacturers of key sensor and sub-systems technology and the data-linking and networking and systems integration requirements. This should be followed by clear parameters regarding volume and power consumption. The design of the aircraft should optimally be built around these systems rather than having the systems conform to a pre-conceived design.

4) A joint Public-Private document clearly analysing the possible failure points and the necessary de-risking measures to be undertaken.

5) A request from the ADA to the Air Force to clearly spell out effects rather than capabilities and generate a clear understanding of the term “fifth generation”. Independent of the Air Force the ADA should also ask the Army and Navy for inputs on how they would like to see the new aircraft support their operations and what specific army and navy systems it would have to be integrated with in order to bring 5th-generation synergies to the battle space.

Amidst much criticism it is important to point out two things: First, that many contradictions in the design do not seem to be of the ADA's making but rather owing to extremely nebulous parameters such as 'medium' and a cut-and-paste approach imposed by the Air Force. Second, the fact that the ADA has made information available to the public in order to solicit opinion leaves much hope that course corrections are eminently possible.

****

Endnotes:

1. Pandit, "MMRCA Deal: India to Scrap $20 Billion Mega Project for 126 Rafale Fighter Jets - The Times of India."
2. Sonwalkar, "Modi in France: India to Buy 36 Rafale Jets in 'fly-Away Condition.'"
3. Ibid
4. Dowerah, "Two New Rafale Squadrons Are Fine, but IAF's Dwindling Fighters a Worry: Former Air Marshal Gogoi - Firstpost."
5. Kopp, "Search and Acquisition Radars (S-Band, X-Band)."
6. Toensmeier, "BMI Suppliers Target New Grades At Broader Market Penetration."
7. "UK's First F-35 Flies [the IRONIC 'B' Model] - F-35 Milestones."
8. Winchester, Jim, ed. "Northrop/McDonnell Douglas YF-23", Concept Aircraft. Rochester, Kent, UK: Grange Books, 2005 pages 198-199
9. Aroor, "LIVEFIST: The Stealth In India's Advanced Medium Combat Aircraft (AMCA)."
10. Mallikarjun, "Astra Missile Fired Successfully from Su-30MKI Fighter Jet in Two Trials - The Hindu"; Tv, "Know More about India's First Laser-Guided Bomb Sudarshan."
11. "Eurofighter Typhoon | The World's Most Advanced Fighter Aircraft."
12. Selex ES Ltd, "RAVEN ES-05 ACTIVE ELECTRONICALLY SCANNED ARRAY (AESA) FIRE CONTROL RADAR."
13. Ibid.
14. Defense Acquisition Management Information Retrieval, "Selected Acquisition Report (SAR):F-35 Joint Strike Fighter Aircraft (F-35)."
15. Kopp, "Assessing Joint Strike Fighter Defence Penetration Capabilities."
16. Ibid.
17. Global Security, "F-35 Joint Strike Fighter Lightning II."
18. Joshi, "Video: Vayu-StratPost Air Power Roundtable IV | StratPost."

ABOUT THE AUTHORS

Abhijit Iyer-Mitra is Programme Coordinator, ORF National Security Programme.
Pushan Das is Research Assistant, ORF National Security Programme.

Observer Research Foundation
20, Rouse Avenue, New Delhi-110 002
Phone: +91-11-43520020 Fax: +91-11-43520003
www.orfonline.org email: orf@orfonline.org