



The Incredible Journey of Indian AWACS

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I have not seen an aeronautical book quite like this before – certainly not in India – where the technical story of aircraft projects, deals as much with their problems and difficulties as with the ingenious solutions the engineers found, and as much with failure as with success. The first author, Dr K Ramchand, the pioneer in India in the design and development of early warning surveillance aircraft, and his two co-authors, colleague and airworthiness expert S Krishnasamy and science journalist B R Srikanth with a passion for writing on aerospace, have produced a book that is as attractive as it is illuminating.

To give the reader some idea of the nature of the book, it may be useful to summarize its main subject. It is the fascinating story of two DRDO projects (separated from each other by about two decades) on aerial early warning surveillance aircraft. The first such project was in part triggered by the 1971 Indo-Pakistan War, and later on by the concept of the Revolution in Military Affairs (as it was termed in the US) that digital technology had brought about. In 1985 a project organization called ASWAC (Airborne Surveillance Warning and Control), headed by Air Marshal Gole with Dr Ramchand as Chief Executive Officer, was set up for the project, which acquired the code name AIRAWAT. In 1991 a Centre for Airborne Systems (CABS) was set up with Dr Ramchand as the Director. Early studies of an ASWAC configuration considered various possible platforms, including the Russian IL-16 suggested by AVM S Krishnaswamy. On a visit to CABS the Russians apparently said, 'You are on the right path, but you are still a child and have a long way to go!' The platform finally decided on was the HS-748, as suggested by Prof Satish Dhawan, who knew a great deal about the aircraft from an investigation he had carried out for the Civil Aviation authorities (and one in which both Air Marshal Gole and I happened to be involved). Section 1 of the book has a very interesting account of the genesis of the HS148/AWACS (Airborne Warning and Control System) project, using a rotating radar (rotodome) on the fuselage. Wind tunnel measurements were made at IISc (by Prof M A Ramaswamy), with detailed calculations which showed that the project was feasible if careful attention was paid to keep any additional drag very small. As Prof P R Mahapatra (also of IISc), whose valuable support to the programme throughout was acknowledged by its leaders, pointed out that the AWACS was *software-intensive* (as we shall shortly see). Dr Ramchand proceeded with the project at CABS, and the aircraft flew very well indeed, appearing in the Aero India air shows in 1996 and 1998. Between 7 and 10 January 1999, the aircraft made 11 sorties on the sea-coast at Arakkonam, and the results amazed and thrilled the team, but unfortunately the next flight crashed and all the eight occupants lost

their lives: the problem was a flaw in the rotodome support system that wrenched it from the fuselage.

Section 2 is about the AEW&C (Airborne Early Warning and Control) aircraft for which the Brazilian Embraer (EMB-145) was eventually chosen. A major advance over the previous aircraft was the substitution of the rotodome by an Active Electronically Scanning Antenna radar (AESA) which had been developed in the mid 1990's. This system was less complex and lighter, so promised operationally more effective surveillance. After detailed discussions with Embraer, with certain modifications to meet Indian needs (resulting in an Indian version designated as EMB-145I), the project was formally approved in 2004. This time a new management system, replacing the earlier committee system headed by the Raksha Mantri, was adopted. Dr S Christopher became the Programme Director with a Programme Office, and there were Project Directors at CABS and other DRDO centres working on parts of the surveillance 'system of systems'. The new system of management adopted is worth noticing, as it seems to have worked very well. The key needs were identified as critical technologies needing innovation, strong management, tools and techniques, building up trained manpower, and world-class infrastructure. The Programme Office had eight units and a Product Life Cycle Management System; a Monitor of Progress connected all the teams. The EMB-145I carried five to seven subsystems more than the HS-748 had done. The rotodome used on the HS748 was replaced by the AESA Radar. (The radome was cladded, thanks to a comment made by Prof. Mahapatra in a brain storming session of about how the radio frequency losses would double while scanning.) For the first time in an Embraer aircraft there was an in-flight refueling capability (which DRDO got free, enabling Embraer to sell it as an option on its future sales, without making continuous payment to DRDO for its contribution). Although there were some delays, the project teams began work on all the required systems/subsystems based entirely on indigenous design and manufacture, except for using foreign electronic components that were openly available (as they were not yet made in India, which is a continuing weakness). Software, for security reasons, was entirely written here (involving 100-200 man years of effort; it would have cost about Rs.100 cores to get it done abroad). Although the way of estimating the expenditure in India by the prevalent government rules would indicate only a rather small sum spent on the project in-country, the pricing system followed by private industry (which charges for knowledge and all other related expenses as well) suggests that the indigenization component would account for about 80% of the cost as India's contribution to the Project.

The Indian order on Embraer 145I was for three aircraft, and the first flight took place in June 2011 in Brazil. Even as the testing programme continued in Brazil, the second aircraft was delivered in August 2012 and the third in December 2012, both with partial certification (which was permitted: only the first had to go through the whole testing programme). The testing in India continued and the aircraft flew in Aero India 2015, and many Middle Eastern and South Eastern countries immediately expressed great interest. The aircraft was introduced formally into service under the name NETRA in February 2017 at the Aero India Show in Bengaluru. It is clearly a world-class aircraft that has won the acclaim of both IAF and the Indian Navy, as much for its performance as for the cost to India, which is about half of what it would have been if imported. This clearly shows the power and potential of the 'Make In India' policy that was adopted by DRDO for the project.

And it has fulfilled the dream of Dr Ramchand, who had started playing a fundamental role in the design of aerial surveillance systems in India more than 30 years earlier.

There are many important lessons to learn from this successful project. From an ASWACS India to AEW&C India has taken us more than three decades. But the progress achieved has been remarkable in showing how the talent necessary for design and development of a variety of systems is available in India at a fraction of the cost in the developed countries. This is possible provided talent is encouraged and rewarded, a proper management system is set up, and the project exploits the specialized abilities that are available in the various DRDO centres, the national laboratories, academia and private and public sector industries. The book gives a detailed account of the way that various sub-systems were designed and manufactured with the help of all the other centres mentioned above, but for those who may not have the time to read the whole book, there are very pleasant and readable passages in blue blocks throughout the book, very effectively summarizing what was achieved and how ! I consider the book essential reading for all those engineers who would love to see an Indian aircraft industry that has a global presence and is economically and technologically more than competitive – both domestically and internationally. I congratulate the authors for having made fundamentally important points about what Indian aeronautics now needs, in a style that it is at once both comprehensive and clear, with very readable and attractive summaries scattered throughout the book for those who want to get at the essence of it as quickly as possible !

What at first sight looks like a coffee table book with all its numerous glossy and attractive photographs is in fact a great deal more, with its comprehensive and analytical accounts of the design and development of two different aircraft types as Airborne Surveillance Platforms, accompanied by some very important conclusions and lessons that lead to a strong message about the great potential that India has to become a global player in military aeronautics (let us not forget the LCA), and indeed civil as well. It is time for India to be more ambitious !

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