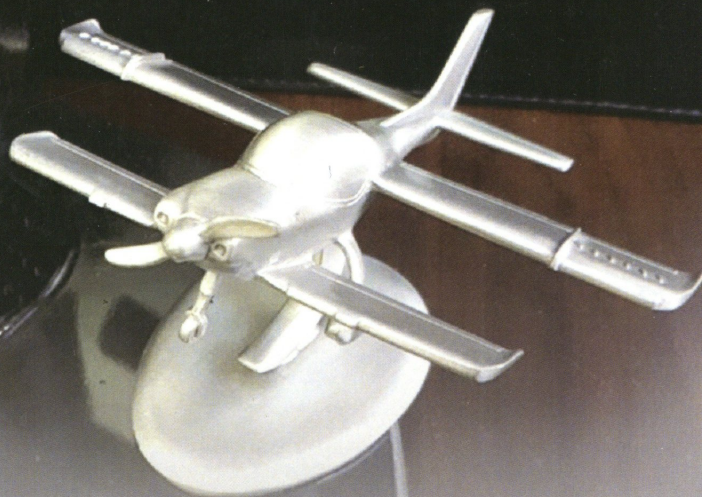




**EAGLE AIRCRAFT**

# THE FLIGHT HOME



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# EAGLE AIRCRAFT THE FLIGHT HOME

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ABU



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# DEDICATION

The Eagle Team has given me the motivation in writing this book. Members of Eagle Team have been providing the photos and the piece of their stories as the contents of this book. This is the record of their sweat and tears in the foreign land to bring the aerospace composites manufacturing and assembly technology home for Malaysia.

# ACKNOWLEDGEMENT

There are many more stories to write but, in this edition is the author's story, who will try to be inclusive and try not to miss anyone who has contributed to the Eagle aircraft program. However, due to the abundance of information, the author has retained only the relevant story of the Eagle aircraft team. Thanks to the team, who have excelled in their careers and life after the Eagle aircraft project. Some of the Eagle team members are now happily retired and enjoying their retirement life. Some have decided to remain in Perth and have taken different paths in their careers. I would also like to thank the Australians in the Eagle team, who have been working together with our Malaysians, sharing their knowledge, skill, and experience. The author acknowledges the contributions of their experience with the Eagle Team to ensure the success of the 1st Malaysia aircraft project.

*Abu Hanifah Haji Abdullah*

# FOREWORD – NAWI ABDULLAH

## **Eagle Aircraft - A lifetime experience**

*"The Eagle Aircraft was born by accident, rather than by pre-meditated design" – Nawi Abdullah*

The Prime Minister, Tun Dr Mahathir Mohammad, in his industrialization plan wanted to introduce a new industry called "Composites Manufacturing" into Malaysia to promote technology growth and intellectual property. Thus, there was a need to search for a suitable specialist partner or willing advanced nation who could facilitate the transfer of technology to Malaysia. and to this end, the Science Advisor was tasked to implement the setting up of The Technology Development Centre, manned by appropriate experts as necessary.

The search began in earnest. The opportunity came from a company in Perth, Australia, called Composites Technology Pty Ltd (CTPL) which needed capital injection. CTPL had in 1983 developed a Proof of Concept two-seat aircraft built from composites, called Eagle XTS. The project was shelved due to a lack of funds. Malaysia decided to provide the funding and, in the process, owned 50% of CTPL. The new joint venture company was renamed Eagle Aircraft Pty Ltd (EAPL) and in January 1991, the Eagle Project was revived. As part of the

agreement, Malaysia had to provide a Technical Team to be attached to EAPL, to begin the learning process and facilitate the transfer of technology to Malaysia. A time span of three years was planned.

I was picked up from Airod Sdn Bhd to head the Malaysian Team. Thus, Composites Technology Research Malaysia was formed, a company then owned by the Ministry of Finance (MOF), and I was the first Employee.

I arrived in Perth on 01 June 1991 and was appointed as Director of Quality in EAPL. Six months later I was joined by three engineers and seven technicians to fill up various positions in the company. It was indeed a very heavy task as the facility and manpower had to be scrutinised, examined, and certified by CAA Australia. We had to prepare the appropriate documents for CAA Australia, the mandatory requirement before any work could commence. A consultant, Graham Swannell, was also employed to write the manufacturing processes and procedures to support the Production, and finally on 13 March 1992, approval was granted by CAA Australia for EAPL to manufacture and Test Eagle XTS.

The initial task for EAPL was to produce two Proto-Type models for Ground Tests and Flight Tests. At the same time, in-house On-Job-Training (OJT) was mandated for all Malaysian personnel, to be certified by Director Quality in six months' time. So, the production was slowed down by the burden of training, and many manufactured parts failed in the process. At the same time, it was discovered that the moulds, equipment, and tools used to build the Proof-of-Concept aircraft were unsuitable for the manufacture of the Prototype aircraft. Thus, new moulds had to be manufactured and old equipment had to be replaced. This further delayed the Project by another

three months. The initial designs also proved to be inadequate, and we had to make new changes and produce new drawings. The new model had to be tested as well.

Production had become a major problem. I was moved to take over as General Manager of Production. With such a heavy burden, another production engineer was brought in from Malaysia. With the determination and full support of the production team, production improved, and parts began to pass all the stringent tests, as our plan was to get the aircraft certified to the European Very Light Aircraft (VLA) Category.

All manufactured parts are tested in batches except for major components such as the Wing and the Fuselage, which require only initial tests to be examined and passed in the presence of a CAA Australia engineer. The Assembly too, required the presence of a CAA Australia Engineer during Tests. We had experienced one major failure when a wing under tests buckled when the applied loads were tripled as called for. We had to go back to the design board and re-evaluate and modify the existing design so that the new wing could support the applied loads as required.

The next challenging task was Engineering Integration, not only of each system but of the systems combined. Engine integration proved very vital. On one of the flight tests, the engine suddenly slowed down to stalling speed. An investigation found that a steep turn had restricted fuel flow, and a change of component solved the problem. Similarly, the integration of the main wing to the fuselage was an elephant to handle. And on top of that, the undercarriage was carried by the fuselage. Structural testing of the assembly proved difficult too, as the assembly really carried a different load distribution. So, to counter this problem we simulated an increased load to

be confirmed by flight tests. The CAA Australia Test Pilot accepted our approach and duly completed the flight tests. Of course, it was supported by mountains of engineering load calculation!!!! This is the part that was enjoyed by Abu Hanifah Haji Abdullah now Associate Professor at UniKL MIAT

The flight testing took place after a four-month delay, but it was completed in one month, and then re-confirmed by the CAA Test pilot in one week. The shortcoming of Eagle Aircraft was that it was designed not to stall. As the aircraft slowed down, the nose began to dive, but as the nose-dived, the airflow provided Lift to the front canard wing, and the nose raised. The whole process of phugoid and the aircraft refused to stall. So how did we check for stalling speed and its flight envelope limits? It took the Test Pilot a week to think about how to achieve the process to meet the regulatory requirement. He did it by going near stalling and banking the aircraft to avoid the canard wing gaining lift. To me, it was a heroic act worth mentioning, as the aircraft could have crashed during banking when the lift went to zero.

Whilst all those activities were going on, the other ground facilities were also being built, such as the Spray Shop, Upholstery Shop, Weight and Balance Shop. These facilities must be ready as scheduled by production. At this time, we also brought in experts from Malaysia to speed up operations without the need for training. For example, one aircraft sprayer, Zolkefli Abu Bakar, had years of experience with the Royal Malaysia Air Force and Airod Sdn Bhd. So, the certification by the CAA was quick and smooth. Also, by this time, the Malaysian Team was fully certified as competent for each of their specialties. At the same time, we had to produce all the necessary Manuals associated with the aircraft, such as

Maintenance Manual, Operating Procedures, Safety Standards, and Approved Vendors. Spare Parts Lists. The job was outsourced to a known CAA-certified company Graham Swannell as EAPL did not have the manpower or expertise in this area of specialisation. The next task was to compile all the design work, manufacturing processes, quality practices, structural test results, flight test results, and the Manuals for submission to CAA. It took them three months to go through with tons of questions for EAPL to reply to and justify. At the end of which The Chief Designer and Director of Quality were grilled to the satisfaction of the Authority.

Finally, on 21 September 1993, Eagle XTS received its Type Approval Certificate. Hooray, the First Malaysian-built Aircraft was duly certified. We organised a Roll Out ceremony on 05 October 1993, in the presence of Mr. Hendy Cowan, the Deputy Premier of Western Australia with great funfare and the feeling of huge achievement. Many of us shed tears too. For me personally, it was a huge load taken off my shoulders. We shipped back this aircraft to be presented at LIMA Airshow in December 1993. But before that, we arranged for the Prime Minister to fly with our Test Pilot as a thank you gesture for his great ambition. The Prime Minister flew the aircraft on 4th December 1993.

I would like to thank all personnel (The List is too long) in Eagle Aircraft Australia Pty Ltd for their loyalty and unquestionable hard work to make this dream possible. My special thanks to the Malaysian Team and their accompanying family members who had to endure living in a foreign city to support me come rain or shine.

Finally, I am humbled by the trust given to me by my Prime Minister. I was promoted to Chief Executive Officer (CEO) the following year.

*Signed off*



**NAWI BIN ABDULLAH**

MSc BSc Dip Marketing, CPL, ex-Chief Executive Officer  
Eagle Aircraft Australia Pty Ltd.

# ABBREVIATIONS

<b>CTPL</b>	Composites Technology Pty Ltd
<b>TC</b>	Type Certificate
<b>TCDS</b>	Type Certificate data Sheet
<b>SBJ</b>	Secondary Bonding Jig
<b>EAPL</b>	Eagle Aircraft Pty. Ltd.
<b>CAA</b>	Civil Aviation Authority
<b>CASA</b>	Civil Aviation Safety Authority
<b>DCA</b>	Department of Civil Aviation
<b>FAA</b>	Federal Aviation Administration
<b>JAR</b>	Joint Aviation Regulations
<b>VLA</b>	Very Light Airplane
<b>PLM</b>	Plastics Layup Mould

# DISCLAIMER

The contents of the books, including the photos and documents are the collections from the Eagle Team members while they served the Eagle Aircraft. The authors provide the information to the best of their knowledge. The authors are not responsible for any damages incurred.

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Author



**ABU HANIFAH HAJI ABDULLAH** served the EAPL from January 1994 to September 1996 in design and certification, and later became the Project Manager for the recertification Program. He was also the Acting Engineering Manager in 1996. Later, resigned to join the Department of Civil Aviation (DCA) Malaysia and came back as the certification airworthiness engineer for Malaysian Type Certification (TC).

Co-author



**KHALIZI RAZAK** was the Resident Engineer under C & S consultant company; MR Perunding Sdn Bhd for the construction of CTRM complex in Batu Berendam. Upon completion, he joined CTRM as Maintenance Engineer and subsequently absorbed under Eagle Aircraft (Malaysia) Sdn Bhd, as part of the Engineering team. Throughout the years he had served in various capacities in various companies under the CTRM group of companies. His last position in CTRM is as CEO of CTRM Aero Composite Sdn Bhd.



**MOHD JAMIL JAHYA** was the pioneer batch of Eagle Aircraft. Joined Eagle Aircraft Pty Ltd in April 1993 in Perth. In 1997 back to CTRM Melaka, developing the manpower skill for Eagle Aircraft parts manufacturing. Involved as the planner of the Manufacturing Plan in 2000. In 2003 heading the Eagle ARV (Aerial Reconnaissance Vehicle) Maintenance Department in Labuan. Eagle Aircraft were converted and became the first Malaysian ARV which was awarded to TUDM. In 2006 joined UST (Unmanned System Technology) developing the Malaysian made UAV which is another diversified project of CTRM. Later became the UST Head of Quality Department and left for own business in 2016.

Co-author



**MARTIN GOMES** joined Eagle Aircraft Australia Pty Ltd Perth on January 1994 as an Aircraft Assembler and was part of the pioneer batch for this technology transfer endeavour. He was transferred back to Melaka in July 2000 and later became the Program Manager for the Eagle Aircraft Program in October 2003. He was then moved over to CTRM AC in October 2005 as Program Manager for the A400M Programs and later to Head of Program for the Goodrich (now Collins) Programs which included the Boeing 787 Rolls Royce (RR) and General Electric (GE) Fan Cowls manufacturing in March 2010. In April 2014, he progressed further to Senior Manager - Head of Division Program Management 1 encompassing all Airbus related manufacturing programs (for the A320, A350, A380 and A400M) at CTRM AC. He has since retired in July 2021 with a total of 41 years of experience, of which more than 27 years of service at CTRM whilst working his way up the ladder through rank and file.

Co-author



**NAZRUL HISHAM NAWI** was part of the 2nd batch of engineers who joined CTRM in 1995. He was seconded to EAPL in Perth to be part of the recertification team from March 1996 to 1999. He was then transferred back to Melaka to help setup the EAM Engineering team which eventually received the TC transfer from EAPL Australia and responsible to support the aircraft design and continuing airworthiness function comprising all Malaysian engineers. He then took up the Chief Design Engineer's role for the Eagle Aircraft from 2002 and other various roles in CTRM until he left in 2016.

Co-author



**AHMAD SHIBLI KUSASI** was the pioneer batch at Eagle Aircraft Pty Ltd, Perth, Australia, joined the Tooling Department, November 1993. It was 1998, back to Melaka, to develop Eagle Aircraft Malaysia. CTRM Aero Composite was then formed and have been attached to the Production, Tooling Program Vendor Development and a keen advocate to Lean Manufacturing. Will end the tenure, after 29 years with the Composites Manufacturing industry



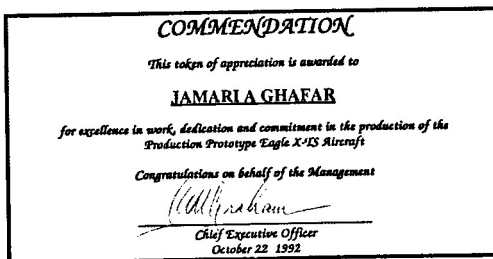
**SAIFUL BAHAR RAMLI** was the pioneer batch of Eagle Aircraft. Joined Eagle Aircraft Pty. Ltd, Perth, Australia in April 1994 and pursued an Advance Composites Tool and Mould Manufacturing certificate at Composites Unlimited International (CUI), Australia. Between the years 1994 to 1999 had involved directly with the set-up of Eagle Aircraft manufacturing base in Batu Berendam, Melaka, Malaysia. Also, one of the pioneers in aircraft manufacturing through advanced composite materials in the CTRM Aero Composites. Beginning of the year 1998 had mostly spent time in the Quality Environment at CTRM Aero Composites. Currently hold a position as a Program Quality Engineering Manager at CTRM Aero Composites, Melaka, Malaysia which had involved on many Aircraft manufacturing programs such as Spirit, Collins (Goodrich), Airbus Military (ADS), Airbus and Boeing commercial airplane and continuously spend 18 years in Quality and management environment especially in Advance composites manufacturing.



**SHEIKH SHAMSHRUL HEDRA SHEIKH MUSA** joined Eagle Aircraft PTY LTD, Perth in January 1994 and was attached to Aircraft Mold, Tool, Jig and Fixtures Department. Worked his way from a Tooling Technician to an Aircraft Tooling Specialists. Involved in every single process and manufacturing of Eagle Aircraft Molds and Jigs. Heavily involved in designing custom parts for the aircraft with Engineering Department. Most notable achievement was when he and his Team managed to build up the **Eagle Assembly Line** which was certified by **CAA** and **FAA** in Eagle Facility in Perth. Another achievement was when he managed to **DISMANTLE** the whole Assembly line in Perth and **RE-ASSEMBLE** the whole line back in Melaka, Malaysia and to top it all, managed to get it certified by DCA (CAAM). Considered to be the **FIRST MALAYSIAN** ever to build up a **Composite Aircraft Assembly** Line in MALAYSIA. Fills up most of his free time by engaging with activities organized by the **MALAYSIAN STUDENTS OF PERTH, MALAYSIAN TOURISM OF WESTERN AUSTRALIA, AL-HIDAYAH ISLAMIC SCHOOL BENTLEY, and MALAY ASSOCIATION OF WESTERN AUSTRALIA (MAWAR)**. Also a part time **DJ** for **RADIO MELAYU PERTH** which aired on every Saturday through **6EBA, 95.3FM**.



**JAMARI A GHAFAR**, as Aeronautical Engineer for Composites Aero-Structure and Quality Assurance, Eagle Aircraft Pty Ltd, Fremantle, Western Australia. Began a career in the aerospace industry while joining Composites Technology Pty Ltd, Australia (trading as Eagle Aircraft International) as Aircraft Parts Inspector, a pioneer team member on the roll-out Eagle XTS pre-prototype tail registered VH-XEP later redesigned as Eagle XTS-150. His last position in CTRM was as Assistant General Manager for Research and Technology before leaving the company after more than 26 years of service.



Co-author



**ANUAR GHAZALI.** He was the 2nd batch of engineer joined CTRM (M) Sdn Bhd in 1995. Later moved to EAPL in Perth to be the flight test engineer for the Eagle 150B recertification and moved up to be the CEO of the Eagle Aircraft (M) Sdn Bhd. He is now a businessman.

# 1.0 INTRODUCTION

The flight home for Eagle took an adventurous journey. The author set foot in Western Australia to learn and bring composite manufacturing technology home, which the author never had experience designing and manufacturing composite parts.

It is not easy to develop technology from scratch, the fastest route is to learn, acquire and develop from an established organisation and further develop the technology to the next level.

Tun Dr Mahathir understood the challenges in developing the technology from scratch, therefore, he decided to acquire the technology through acquisition of companies with the existing technology and brought in Malaysians into the company to learn, work and further develop the technology to a higher level.

This book walks through the Malaysian Eagle team's journey from setting up the modern aircraft factory in Perth and re-establishing the more modern manufacturing line in Batu Berendam, Melaka.

## **2.0 4TH MALAYSIAN PRIME MINISTER VISION AND MISSION ON ADVANCED TECHNOLOGY DEVELOPMENT FOR MALAYSIA**

The 4th Prime Minister, Tun Dr. Mahathir Mohammad, had the vision to bring Malaysia into an industrialised nation and possess the state-of-the-art modern technology. The development of new materials technology may have inspired him to acquire composite technology for Malaysia.

In the 1980s composite materials were introduced to make aircraft structures and it became more sensational with the design and development of the Beechcraft Starship. It is a tailless aircraft, built using 100% composite materials for its structure. The development began in 1982 when Beechcraft approached Burt Rutan of Scaled Composites, a leader in the field of novel composite aircraft design. The design was done digitally using the Computer Aided Design (CAD) software, the CATIA.

Tun Dr Mahathir saw the opportunity from Composites Technology Pty Ltd (CTPL), a company in Perth, Western

Australia, which needed capital injection. CTPL had in 1983 developed a Proof of Concept two-seat aircraft built from composites, called Eagle XTS. The project was shelved due to a lack of funds. Malaysia decided to inject the funding and owned 50% of CTPL. The new joint venture company was renamed Eagle Aircraft Pty Ltd (EAPL) and in January 1991, the Eagle Project was revived.

Part of the agreement, Malaysia had to provide a Technical Team to work for EAPL, to begin learning composite technology and facilitate the transfer of technology to Malaysia for a time span of three years. Soon, the Composites Technology Research Malaysia (CTRM) was formed, a company then owned by the Ministry of Finance, to facilitate the technology acquisition and development in composites.

The earliest technical team was employed by EAPL through CTRM Sdn Bhd. They were not just learning the technology but have been instrumental in developing the advancement of the technology toward manufacturing. Their experience from Airod Sdn Bhd and Petronas have helped them to understand the new technology and to develop the manufacturing and assembly processes.

Ironically, most of them were from Airod Sdn Bhd, which was another result of Tun Dr Mahathir's vision to be independent in military aircraft maintenance, repair and overhaul. This group of technicians from Airod Sdn Bhd has proven Tun Mahathir's vision of Malaysia to be an industrialised nation was a success. The initial strategy was to learn to maintain, then later learning to manufacture before learning to design, seems to fall in place.

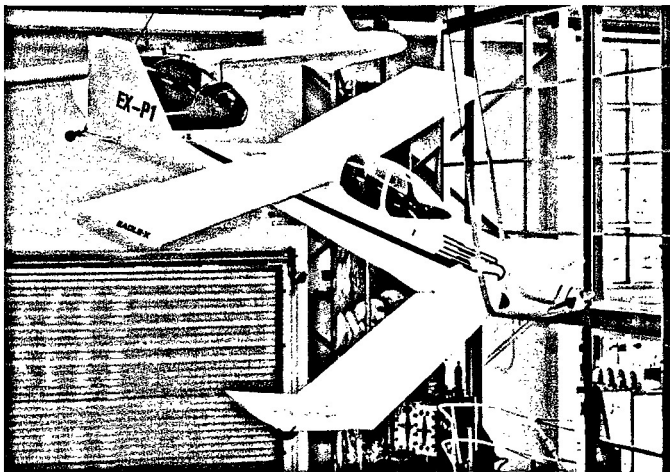


Figure 1: The 4th Prime Minister Tun Dr Mahathir Mohamad enjoying his time in the Eagle aircraft cockpit.

The success of the Eagle made Tun Dr Mahathir believe that the composite materials are the materials for the future and to be developed in Malaysia to encourage foreign companies to establish their presence in Malaysia, which will be the Foreign Direct Investment (FDI) for Malaysia. Today, Malaysia has two major composites manufacturers in the world: CTRM Aero Composite Sdn Bhd in Melaka and Aerospace Composites Malaysia (ACM) in Bukit Kayu Hitam, Kedah. More companies have also invested in manufacturing composite aircraft. These companies are the evidence of the visionary Tun Dr Mahathir Mohamed.

# 3.0 DESIGN OF THE EAGLE AIRCRAFT

The Eagle was designed by the famous Australian aircraft designer, Graham Swannell, and the aerodynamic profile was developed using Computer Aided Engineering (CAE) software, Computational Fluid Dynamic (CFD) VSAERO, by the famous American aerodynamicist John Roncz.



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