

ISSN: 2791-3406
Volume 05, Issue 01, May 2026

SPACE & BEYOND

An AAUB Publication



04

COAS MESSAGE



Hasan Mahmood Khan
BBP, OSP, GUP, nswc, psc
Air Chief Marshal
Chief of Air Staff
Bangladesh Air Force

The Bangladesh Air Force remains steadfast in its commitment to supporting the growth and progress of the Aviation and Aerospace University, Bangladesh. Together, we shall continue to strive for excellence and uphold our shared vision of advancing the nation's capabilities in aviation and aerospace.

21

FLIGHT SAFETY

Harnessing the Power of Data Analytics in Enhancing Aviation Safety: A New Era of Risk Management

The future of aviation safety worldwide is evolving from conventional investigation techniques toward data-driven risk management, and in this context, analytics plays a vital role. The growing aviation sector in Bangladesh and institutions like the Aviation and Aerospace University of Bangladesh (AAUB) must embrace and adopt such technology to ensure a safe and efficient aviation industry.



08

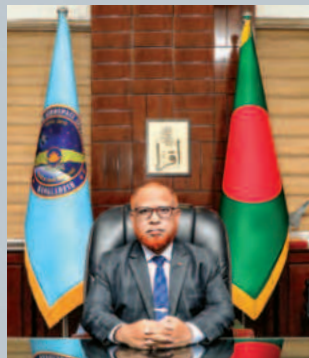
CENTRAL THEME

The Literary Value of Science

The power of science lies in mastering its technical skills and specialised tools. The contributions to making science a literary genre come from the brilliant men who are scientists themselves. No man of arts would be able to do so because he lacks the requisite qualifications.

05

RENDEZVOUS



Aviation and aerospace belong to those who dare to venture into this realm

Air Vice Marshal M Mustafizur Rahman
BSP, GUP, nswc, afwc, psc
Vice Chancellor, AAUB

We are not an air or space-faring nation. Our people hardly dream of flying or walking in space. Therefore, this university has a sacred responsibility to promote and encourage dreams in aviation and aerospace among our future generations.

29 AVIATION LAW

Unmanned but Unregulated? Examining Bangladesh's Drone Law and National Airspace

The use of unmanned aerial vehicles (UAVs), popularly known as drones, has grown rapidly in Bangladesh over the past decade. From media coverage and academic research to surveying, agriculture, and recreational photography, drones are increasingly visible in the country's skies.

12

PERSPECTIVE

Understanding the Myth of UFOs through the Lens of Islamic Theology

The famous "Roswell of Brazil" incident in 1996 described that one extraterrestrial craft/alien craft crashed; three sisters from a single family were in contact with extraterrestrial beings who were then taken to hospitals and later transferred to the USA.

VIEWPOINT

17 Beyond the Horizon My Journey at AAUB

34 The Journey of Hope from Bangladeshi Skies to Global Stage: Team Ababil's CanSat Odyssey

20 MILESTONE

Homebound Wings

Arif slowly woke up as the aircraft began its descent to land. As his wristwatch ticked, his chest tightened with emotions he could not express. Outside the window, the morning sky glowed softly.

26 SPACE ECONOMY

Rockets to Realities— Where Aviation Meets the Space Economy

In Bangladesh, the space economy and aviation growth are not distinct policy domains; they are intricately linked through technology, workforce development, infrastructure, and national strategy.



36 ENGINEERING

Where Wings Meet Inclusion: Engineering Belonging in Aviation and Aerospace

The aerospace engineer and astronaut Kalpana Chawla is an example of a person with a humble origin that made it into space and proved that anyone in the world can be part of the global space science community.

31 ANALYTICS

Low-Cost Airlines and Market Efficiency: The Bangladesh Perspective

Low-cost airlines follow some simple but innovative ideas to make air travel popular and affordable for a large number of people. Their main strategy is to offer lower ticket prices, which they achieve by keeping service costs low.

24 CHANDRA

Moon Missions The Science behind Different Travel Times

The Moon has been a source of wonder since the dawn of humanity, sparking countless myths that endured well into the nineteenth century. While the invention of the telescope provided our first clear glimpse of the lunar surface, the true secrets of our celestial neighbour only began to unfold when humans entered its orbit and eventually set foot on its soil.

18 SYNERGY

AI in Air Traffic Management: Transforming the Future of Aviation

AI-based systems for managing traffic flow use historical and real-time data to predict air traffic demand and identify potential congestion points.

15 SCI-FI

The Vortex of Tomorrow

It all started like any other day. I was at my desk, eyes glued to the screen, tweaking the flight algorithms for a new generation of drones. The work was engrossing—drones that could navigate urban landscapes with a near-perfect understanding of their environment, drones that could save lives in disaster zones.

Editorial Note

The horizon of aviation is no longer confined to the skies; it now stretches into the vast and transformative frontier of space. In this edition of *"Space and Beyond"*, we present a compelling reflection of a nation in transition—where innovation, ambition, and vision are shaping the future of aviation and aerospace in Bangladesh. At the heart of this journey stands Aviation and Aerospace University Bangladesh (AAUB), nurturing the minds and technologies that will define tomorrow.

The message from the COAS, BAF underscores a strong institutional commitment to establishing AAUB as a centre of excellence with global relevance. This vision is further reinforced through the Vice Chancellor's interview, where the university's mission to transform people into Aviation, Space and Technological professional and enthusiast by providing world class education, is clearly articulated. AAUB is not merely an academic institution; it is a gateway to limitless opportunities.

This issue brings together diverse perspectives on the rapidly evolving aerospace landscape. From the expanding space economy and lunar exploration to drone law, data analytics, and aviation governance, the articles combine scientific insight with practical relevance. Equally significant are discussions that connect science with philosophy, literature, and broader human understanding—reminding us that innovation thrives through interdisciplinary thinking.

As global and domestic aviation developments continue to unfold, Bangladesh is emerging as both a participant in and contributor to this progress. The journey from runway to orbit is no longer a distant aspiration; it is an unfolding reality.

We extend our sincere appreciation to our faculty, researchers, official staffs, students, and contributors whose dedication continues to define AAUB's path. This magazine is more than a collection of articles—it is a reflection of a movement towards knowledge, innovation and boundless possibilities.

Thanking you,

Editor

Group Captain Md Tanvir Rahman, afwc, psc, GD (N)
Director
Public Relations & Information Division (PR&I), AAUB

Associate Editor

Wing Commander Kawsara Parvin, AAUB
Asst Prof. Dr Hosne Nasrin, AAUB
Asst Prof. Ziad Bin Abdul Awal, AAUB

Design, Development & Production

Public Relations & Information Division (PR&I), AAUB
Old Airport Building, Ground Floor
Tejgaon, Dhaka-1215
+88 02 50060000
+880 1769 995071
pri@aab.edu.bd, www.aab.edu.bd

COAS MESSAGE



It gives me immense pleasure to extend my warm greetings to the readers, contributors and the entire editorial team of "Space and Beyond", the distinguished Aviation and Aerospace Magazine of Aviation and Aerospace University, Bangladesh. As the country's sole specialized institution in the field of Aviation and Aerospace, this university is stepping into its 7th glorious year. It stands as a beacon of excellence in education, research and innovation in aviation and aerospace sector in Bangladesh. With its highly qualified faculty, state-of-the-art laboratories, modern academic curriculum and enriching academic environment, the university continues to nurture future leaders for the aviation and aerospace sector. Its remarkable achievements in global competitions are a testament to the dedication, talent and professionalism of its students and faculty members.

This flagship magazine is a significant intellectual platform that brings together scholars, researchers and professionals from home and abroad. It plays an important role in sharing knowledge, encouraging innovation and advancing the frontiers of aviation and aerospace studies. I am confident that this publication will continue to inspire critical thinking, foster academic excellence and contribute meaningfully to the growing body of knowledge in this important domain.

Bangladesh Air Force remains steadfast in its commitment to supporting the growth and progress of Aviation and Aerospace University, Bangladesh. Together, we shall continue striving for excellence and advancing our shared vision of strengthening the nation's capabilities in aviation and aerospace sector. I wish "Space and Beyond" every success in its future endeavors.



Hasan Mahmood Khan,BBP, OSP, GUP, nswc, psc

Air Chief Marshal
Chief of Air Staff
Bangladesh Air Force

AVIATION AND AEROSPACE BELONG TO THOSE WHO DARE TO VENTURE INTO THIS REALM

Air Vice Marshal M Mustafizur Rahman
BSP, GUP, nswc, afwc, psc, GD(P)
Vice Chancellor, AAUB

Space & Beyond: As a specialized university, what is your top priority for strengthening the university's academic excellence?

Vice-Chancellor: My top priority is simple; pursuing the purpose with excellence. The purpose of AAUB is to transform people into aviation, space, and technology professionals and enthusiasts by providing world-class education. Aviation and aerospace is a field of technological excellence where any mistake or omission is unforgiving. My job is to prepare my students to venture into that sphere with courage and sound knowledge.

AAUB's academic curriculum has been developed by a committed team comprising aviation and aerospace experts from both home and abroad, which ensured that the curriculum remained current and responsive to the rapidly evolving aviation and aerospace technology.



“ We are now working to hold a nationwide aero-genius competition in October/November 2026 to arouse interest in aviation and aerospace amongst students/college/university levels. ”

We also put strong emphasis on faculty development, research excellence, and international collaboration to ensure a high standard of education. At the same time, we are expanding partnerships with leading universities and industry stakeholders to facilitate student exchange, joint research, and exposure to global best practices.

Space & Beyond: How do you envision AAUB promoting a broader aviation and aerospace-minded nation?

Vice-Chancellor: We are not an air or space-faring nation. Our people hardly dream of flying or walking in space. Therefore, this university has a sacred responsibility to promote and encourage dreams in aviation and aerospace among our future generations.

AAUB seeks to inspire school and college students, as part of building awareness and aspiration, to view aviation and aerospace as viable and exciting fields. To achieve this, we engage students through aviation and aerospace-focused science fairs, local and international competitions, practical projects such as designing and building drones, rockets, small can-satellite (cansat), or autonomous vehicles, alongside establishing dedicated aerospace and robotic clubs. We are now working to hold a nationwide aero-genius competition in October/November 2026 to arouse interest in aviation and aerospace amongst the students of school/college/university levels. In addition, we regularly organize seminars and workshops, and are planning to introduce Fun and Educational stargazing events, allowing students to observe celestial objects up close through telescopes. Besides, AAUB publishes aviation and aerospace magazines and newsletters at regular intervals, which are circulated across academic institutions to create awareness and to cultivate curiosity and ambition among the youth. Through these integrated initiatives, AAUB is steadily working towards developing a vibrant aviation and aerospace-minded generation in Bangladesh.

Space & Beyond: Could you highlight some of the key achievements of this university to date?

Vice-Chancellor: The quality of education has always been the cornerstone of the university's growing reputation and success. Accordingly, a primary focus is placed on ensuring a qualified faculty. The academic programmes are designed to blend theoretical knowledge with practical insight. AAUB also maintains a pool of highly qualified lecturers drawn from both civil and Bangladesh Air Force who have obtained their PhDs from different universities across the globe.

“ AAUB places strong emphasis on innovative research. Over the past five years, its faculty members have produced more than 56 fundamental research publications, including many in Q1 and Q2 journals. ”

Equally important to its achievements is the establishment of advanced laboratory facilities that support hands-on learning and research. The university has invested heavily in specialized labs equipped with modern instruments and simulation technologies. Presently, we have one of the most modern lab facilities in AAUB. The effort will continue to ensure proper learning for our students. Together, a highly qualified faculty and state-of-the-art laboratories ensure a quality educational environment for our students.

AAUB places strong emphasis on innovative research. Over the past five years, its faculty members have produced more than 56 fundamental research publications, including many in Q1 and Q2 journals. Key focus areas include indigenous UAV design and manufacturing; combat aircraft design, predictive maintenance, the use of jute fiber in aerospace applications, indigenous satellite and ground station design, satellite communication systems, as well as autonomous rover applications for extraterrestrial environments and satellite-based air quality monitoring. Another important dimension of our research is the nationally funded HEAT project, under which a state-of-the-art UAV Design Laboratory will be established at AAUB, covering key domains such as aerodynamics, structures, propulsion, composites, flight control, avionics, and swarm technology.

Besides, students have been participating in Global aviation and aerospace-related competitions and successfully showcasing their skills by earning prestigious rankings. To mention a few:

1. AAUB Team secured 1st place in an international light aircraft design competition held in the UK in November 2025.
2. In USA, Can Satellite (CanSat) Competition 2025, AAUB finished in 16th place out of 40 teams and 12th out of 175 universities in the 2025-2026.
3. Earlier, Students secured 2nd runner-up position in Kibo Robot programming in Japan, and also successfully test Cube Satellite launch.
4. Very recently, our AAUB Rover 71 Team has successfully qualified (36 among 116 teams) as a University Rover Challenge (URC 2026), USA Final Qualifier.
5. At present, students are working to launch a CubeSat in orbit containing sensors for weather examination and imaging.

Space & Beyond: What is your long-term vision for the university over the next five to ten years?

Vice-Chancellor: Five to ten years is merely a short-term vision for a specialized, technology-based, dream-driven university like AAUB. We should look through a prism of a minimum of 30 years to call it long-term. However, in the next 5-10 years, we want to develop a firm base through ensuring sound academic excellence. We shall continue our pursuit on research, technological development, and knowledge creation. Equally important is the development of human resources to fulfill our own aviation requirements in the field of management, services, maintenance, engineering, and aviation professionals. For the next 5-10 years, we will be focusing on achieving excellence in those basic fields of aviation and aerospace studies and skill development. Besides, we shall continue to encourage and prepare our next generation to be aviation and aerospace-minded.

Space & Beyond: What are all the job opportunities available for graduates from this university?

Vice-Chancellor: The aviation market in Bangladesh is experiencing steady and promising growth. Currently, the airline industry is anchored by four major carriers, collectively employing more than 17,000 professionals. Moreover, construction of the third terminal at Hazrat Shahjalal International Airport, designed to handle around 16 million passengers and approximately 900,000 tons of cargo annually—reflecting the country's ambition to become a regional aviation hub. At the same time, the government's plan to acquire 14 Boeing aircraft for Biman Bangladesh Airlines further highlights this growth trajectory. In this evolving aviation landscape, the need for a large number of aviation professionals, such as aviators, engineers, commercial experts, legal experts, aviation regulatory consultants, etc., will be met by graduates of this university. In addition, in the military aviation sector, AAUB graduates have diverse career opportunities—including maintenance, operations, academic, and technical training roles.

“ The aviation market in Bangladesh is experiencing steady and promising growth. Currently, the airline industry is anchored by four major carriers, collectively employing more than 17,000 professionals. ”

We can also see a proliferation in the aviation manufacturing and research sector, including UAVs, drones, small satellites, rockets, and factory-level maintenance. We believe that our vast, unexplored aviation and aerospace domain will be led by graduates of this university in the future.

Beyond national prospects, there are also global opportunities for graduates to work with leading organizations such as NASA, ESA, and other international aerospace industries, as well as to pursue advanced research in aviation and aerospace fields.

Space & Beyond: What challenges do you find at the university, and how do you envisage addressing them?

Vice-Chancellor: The challenges are enormous; particularly in the areas of Faculty development and enhancing research competitiveness. We have a pool of qualified faculty. We have taken initial steps by developing world-class laboratory facilities in our campus. Our students are already demonstrating their intellectual excellence using those facilities. We shall continue to strive relentlessly to provide state-of-the-art facilities to our students in pursuance of their academic excellence. Additionally, we are pursuing joint research initiatives, visiting scholar programme, and collaborative laboratories with international aviation and aerospace institutions.

We already have very qualified lecturers and we are placing strong emphasis on their capacity building through higher studies, specialized training, workshops, and

exposure to international best practices. We are also inviting international aviation and aerospace experts to our campus at regular intervals to deliver lectures and exchange ideas, thereby creating a dynamic and enriching learning environment. Probably, the biggest challenge that we dream to undertake is developing a population capable of taking the challenge of exploring the aviation and aerospace domain.

Space & Beyond: What is your message for the youth of Bangladesh?

Vice-Chancellor: Aviation and aerospace belong to those who dare to venture into this realm. Mankind's destiny once depended on land and later to the maritime domain; the future lies in the domain of aviation and aerospace. Aviation and space exploration contribute significantly to sustainable economic development and drive advancements in communication, navigation, and environmental monitoring. This university provides a unique opportunity for those who aspire to venture into this field. Individuals who are willing to take the challenges of aviation and aerospace exploration are welcome to join and contribute to this forward-looking discipline. If you dream of aviation and aerospace, join us. The future of Bangladesh is in your hands.

Space & Beyond: Thank you, Sir, for sharing your insights and vision with us today. We truly appreciate your time and reflections on the future of aviation and aerospace education in Bangladesh. 🌍

Central Theme



THE LITERARY VALUE OF SCIENCE

Air Vice Marshal Dr Mahmud Hussain (Retd)
Distinguished Expert, AAUB

It has almost turned into a pharisaical note that science and literature are the two worlds apart of knowledge. To Luddites, science represents the tool for destroying human civilisation scrapped from the enormous potential of indivisible particles of matter. To technophiles, literature has immersed human attempts in the practice of political chicanery. The battle between science and literature is not new, but in recent times, the debate has taken up some creepy temper.

To ancient philosophers, science was divided primarily into three branches of knowledge, namely, natural philosophy, logic and ethics. Natural philosophy was synonymous with what we call today physics. Logic was an attempt to organise human thought in a step-by-step rational manner, an approach which is akin to mathematics. Ethics searched for

righteousness in human society whose spirit was embodied in religious morals. In that bifurcation of the search for knowledge, the status of literature remained an unresolved issue.

But literature had its distinct place in the Tower of Babel. It was the precinct of those who had their imagination running wild. To

philosophers, nothing that was invisible or perceived by void-rational senses could claim its rightful place in the graceful Mansion of Knowledge. Even Plato derided poetry as an inferior form of depicting truth in his work *The Republic*. In ancient times, when the form of prose was not invented, versification was the purveyor of thoughts that came up so elegantly in the

Notwithstanding, the poets were never considered scientists, nor were scientists poets, because their fields of work were **different and autonomous.**



imagination of Homer, Sophocles, Virgil, Ovid, Pindar, and Aeschylus from distant Greece and Rome and Kalidasa, Valmiki, and Vyasa from near India.

Notwithstanding, the poets were never considered scientists, nor were scientists poets, because their fields of work were different and autonomous. This probably also led them to construct their vantage social status, which reflected individual hubris. Plato was the pupil of Socrates. Socrates never wrote down anything. It is through Plato's Dialogue that Socrates is known to us. If the wise men of the old took poetry as inferior to science as a path to knowledge, what could be the veritable justification for doing so? The ancient philosophers, in trying to open up the space of knowledge to human trials, themselves became victims of their own intellectual arbitrariness. They did not know then it was through one of the poets that we would be knowing the spark of one of the greatest scientists ever to stalk the human mind. Alexander Pope, the English poet, satirist, and critic who wrote in the seventeenth century, eulogised Newton in the following lines:

*"Nature and Nature's Laws
Lay hid in night:
God said, "Let Newton Be"
And all was light."*

Alexander Pope's praise of Newton had an appeal to literary reading. It was to make the story of the scientific man interesting and precious to ordinary readers who were enamoured with the adventures, heroics and tragedies of heroes, villains and charlatans. The appearance of the man of science was short-lived, abridged and often accorded a supra-natural position. The Pope wanted to break that fetter and if comprehended deeply, showed others that scientists were also characters capable of being the centroid of epics, novels and poetry, and that made science more interesting to the joys of readers who took science as a totalitarian project. The very idea that science is posited upon an

impersonal reality is misleading and putting reality before mind negates the fundamental principle of *an a priori* knowledge that forms the basis of our experience.

Our literary mind with a scientific bent has produced incomparable works. Think of

themes of the novels weave through logic, giving the stories a lasting popularity with adults. The books have never been out of print. Any child reading these books will be inspired by their phantasmagoria to search for mysteries in the universe if he takes science in his higher studies.

“ The ancient philosophers, in trying to open up the space of knowledge to human trials, themselves became victims of their own intellectual arbitrariness. They did not know then it was through one of the poets that we would be knowing the spark of one of the greatest scientists ever to stalk the human mind. ”

Lewis Carroll (real name, Charles Lutwidge Dodgson), a mathematician whose works *Alice's Adventures in Wonderland* (1865) and *Through the Looking Glass* (1871) had foreshadowed the enigma of parallel universes much before the modern-day physicists have started looking into its scientific truth. Written for children, the

Our craving for religious literature is based on pure faith but it is the scientists who have often been motivated by their apocalyptic vision to dig into the mysteries of the universe. Isaac Newton spent a lot of time reading the Bible and believed his scientific work was to uncover the prophecies of the Divine Mind. The action of

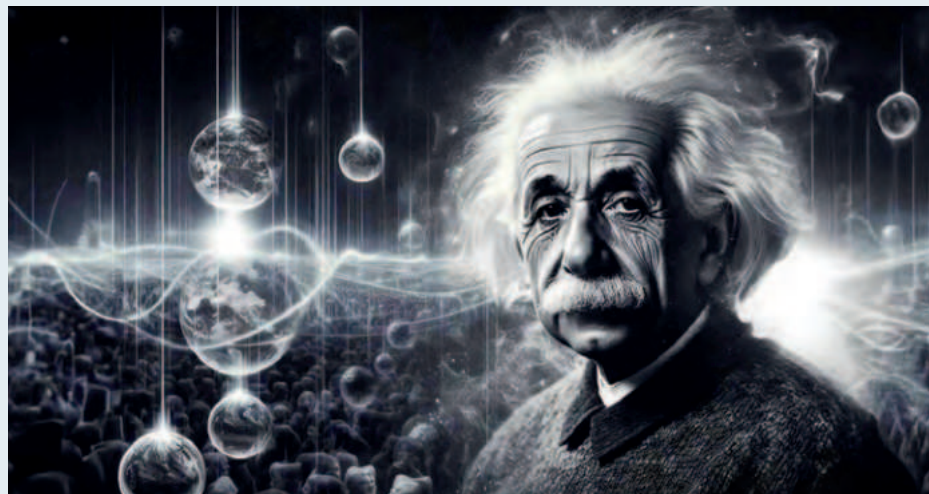
Photo
Sir Isaac Newton's experiments revealed the mysteries of light



force between two bodies at a distance was probably a godly act. The physicist Michio Kaku termed all fundamental forces and particles subordinating themselves to a single unified equation the 'God Equation'. When Einstein was losing his battle to quantum physicists on the issue of the deterministic predictability of a particle rather than its uncertainty, he remembered God and exhorted, "God does not play dice." This interesting and profound interplay between science and religion can only be prepared by the groundwork of the literary terms, statements and hypotheses, not by equations, arithmetic symbols or Wittgensteinian metaphysics. When scientists become literary, their elegance is reflected in the smoothness of their flow of logic, simplicity of the language and earnestness of being accessible to ordinary people.

Einstein's Special Theory of Relativity is imperceptive to common sense because it employs very specialised space-time geometry which disorientates even a science student. Taking time as an essential correlate of the speed of light, one immerses in the infinity of life. Such a notion of time is difficult to comprehend. But when one sees how time behaves near a supermassive black hole by slowing down in the science fiction film *Interstellar*, one understands the nature of time as being both an epistemological concept and a tragedy of human connection. The bond between Cooper, who never grows older because of being a time traveller into space, and his daughter, Murph, who gets old for never leaving the earth, makes for a profound narrative of human love as the fundamental force of our nature. What Einstein did for the mathematicians and physicists, literature has transcribed for the digestion of all.

Einstein famously said, "Imagination is more important than knowledge." Scientific knowledge will get one from A to Z, but imagination will take one everywhere. Our science textbooks are obtusely technical, chronically tedious and temperamentally



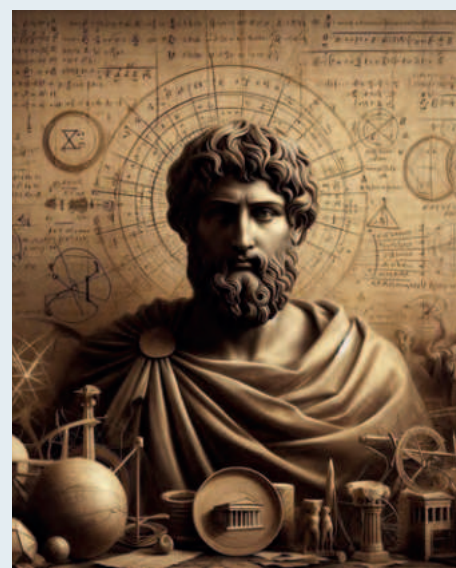
► **Photo**
Einstein's equations meet human emotion, revealing that relativity is not just physics, but the quiet tragedy of connection across time

official. If we are to use imagination in its refined sense at all, it is only a commitment to simple prose, which a scientist could excuse for his lack of verbosity. A whole body of literature has been produced by a corps of scientists in written format and in some of the most outstanding prose of our time whose literary value is simply unparalleled. G.H. Hardy's *A Mathematician's Apology*, J. Bronowski's *Science and Human Values*, Max Planck's *A Scientific Autobiography*, A.N. Whitehead's *Science and the Modern World*, Schrodinger's *What is Life*, and Bertrand Russell's *An Autobiography* are some of the valuable insights into the brilliance of the literary oeuvres of scientific men. Hardy's feelings about mathematics are so majestically captured in the following words that even a talented novelist would envy:

"Archimedes will be remembered when Aeschylus is forgotten, because languages die and mathematical ideas do not. "Immortality" may be a silly word, but probably a mathematician has the best chance of whatever it may mean." (*A Mathematician's Apology*)

The power of science lies in mastering its technical skills and specialised tools. The contributions to making science a literary

genre come from the brilliant men who are scientists themselves. No man of arts would be able to do so because he lacks the requisite qualifications. This is not to demean the man of arts but because the degree of incomprehension in his case to truly fathom the esoteric profundity of nature is untested, and thus remains



► **Photo**
In the spirit of Archimedes, mathematics endures beyond language—the truest form of immortality

Carl Sagan, Brian Greene, Neil deGrasse Tyson, Sean Carroll, Isaac Asimov and Steven Weinberg are as brilliant as **modern poets** and **novelists** in their literary outputs.



“The quantum world fascinates us. It tells us that physics is not merely experimental. Like its twin brother, mathematics, it comes to the minds of physicists as intuition. The spontaneous knowledge takes its support from the foundation of our basic understanding of science. Space is one realm of the human quest for knowledge that scientific writers enrich by their mastery of the language.”

unquestionable. Major moral breakthroughs in scientific works have also come from the scientists themselves. When they have done so, it is purely on the merit of contextual knowledge serving as an input to human experience. Robert Oppenheimer recalled the words of the Bhagavad Gita on witnessing the atomic explosion in the New Mexico desert on 16 July 1945:

“Now I am become Death, the Destroyer of Worlds.”

22 scientists from the Manhattan Project won the Nobel Prize including the famous Niels Bohr, Enrico Fermi, Hans Bethe and Richard Feynman. Oppenheimer himself did not receive the Nobel Prize but he will be remembered more as a man who experimentally proved Einstein's equation. As controversies rage over Oppenheimer's role in the making of the atomic bomb, his literary love of the Bhagavad Gita has rekindled our interest in the epic scripture that continues to be relevant in the age of AI and quantum mechanics.

The quantum world fascinates us. It tells us that physics is not merely experimental. Like its twin brother, mathematics, it comes to the minds of physicists as intuition. The spontaneous knowledge takes its support

from the foundation of our basic understanding of science. Space is one realm of the human quest for knowledge that scientific writers enrich by their mastery of the language. Carl Sagan, Brian Greene, Neil deGrasse Tyson, Sean Carroll, Isaac Asimov and Steven Weinberg are as brilliant as modern poets and novelists in their literary outputs. If there were a Nobel Prize for literature in physics, they could very well claim their entitlement to the award. Steven Hawking's *A Brief History of Time* and *The Universe in a Nutshell* deserve their placement on any household bookshelf alongside the works of great novelists of the stature of Rabindranath Tagore, Salman Rushdie, Amitabh Ghosh and Han Kang.

It is a pity that in our country, the study of science is limited to textbooks only. There is a sharp division in the pursuit of academic disciplines into science and arts. This approach has cost the benefits of learning on two counts. One, a science student considers studying literature a waste of labour, while an arts student would show an apathetic feeling towards a scientific work. The second count is even more pitiful, a resultant fallout of the first one. This

division has created two distinct cultures within the framework of our educational system. The number of books on pure literature which are published every year is disproportionately larger compared to our interest in science fiction.

If we want to construct literary talent out of science, we have to yearn for a scientific revolution in the academic curriculum of schools. Unless the education system builds a structured mind geared to both literature and science in equal measure, there will be a communication void between the two cultures of knowledge. Changes in education are needed to avoid science becoming obtuse in the face of the fast progress of AI and space exploration. This year's award of the Nobel Prize in quantum entanglement, in which two particles become linked in such a way that they share the same fate, no matter how far apart they are, evokes an allegorical phenomenon in which the parallel universes of science and literature need to be entwined. We need to educate our young minds so that one studying arts does not miss the endowments of science and the other studying science does not lack the imaginative experience of literature. 🌌

UNDERSTANDING THE MYTH OF UFOS THROUGH THE LENS OF ISLAMIC THEOLOGY

Group Captain Md Tanvir Rahman, afwc, psc
Director, Public Relations & Information Division, AAUB

The phrase "UFO" (Unidentified Flying Object)—popular in the early 20th century—gained significant attention but was eventually written off as a myth or fiction. Later, the term 'UAP' (unidentified aerial phenomena or unidentified anomalous phenomena) started being used by military and intelligence agencies instead of UFO because it sounds more neutral and scientific, and it includes a wider variety of unknown things like drones or atmospheric effects, not just flying objects. Reports of UAP sightings have been recorded even last year, raising questions about the visit of extraterrestrial life.

Recent stories or confessions from whistleblowers about UFOs/UAPs indicate that many of the old and present UAP incidents seem real. Numerous congressional hearings from 2022 to the present date have exposed UAPs, and the U.S. government has seemingly taken a stance toward declassifying those documents for the public. This process has led to a gradual understanding of extraterrestrial beings potentially living in our and other galaxies and we generally refer to such beings as aliens.

As we examine UAP incidents, we observe that many have occurred throughout human history, and most of these were deliberately fabricated with various narratives and cover-ups. The famous "Roswell of Brazil" incident in 1996 described that one extraterrestrial craft/alien craft crashed; three sisters from a single family were in contact with extraterrestrial beings who were then taken to hospitals and later transferred to the USA. The doctor who was involved in the diagnosis came forward, and the person

involved in the arrest was scratched and later died with an infection. On other occasions, several incidents were exposed by the then-sergeant Clifford Stone from the US Army, who was a part of the Crash Retrieval Program, where he clearly stated his contact with aliens from several crashed extraterrestrial vehicles (ETV). His statement reveals several facts, including that aliens or entities are biological and vary in colour, size, intelligence, and communication skills, such as telepathy. He also mentioned that one time, one of the

Surah Al-Fatiha starts with the verse "Alhamdu lillahi Rabbil Alamin", meaning all praise be to Allah, Lord of all the worlds/universes/creations. Here it says 'worlds' in the plural form, meaning that there are worlds apart from the human realm. So, what else could these worlds be?

beings died, and the other vanished, while their ETV, remaining miles away, also vanished. Stories like these about UAPs continue to circulate endlessly. Lastly, a senior advisor to Marco Rubio, United States Secretary of State and National Security Advisor, said that Marco Rubio believes that the US government has recovered alien technology from non-human sources and is currently working to reverse-engineer it. This rekindled the debate of UFO secrecy. It is also assumed that superpowers such as China and Russia have also encountered similar incidents and have covered up these stories due to their national security concerns.

Let's discuss the Quran and Islamic theology regarding the possibility of extraterrestrial entities on Earth and in the universe. The Quran does not explicitly confirm or deny the existence of alien or alien-like beings. However, certain verses suggest that there are beings, entities, or forms of organic life other than human beings on Earth or in other worlds or universes.

Surah Al-Fatiha starts with the verse "Alhamdu lillahi Rabbil Alamin", meaning all praise be to Allah, Lord of all the worlds/universes/creations. Here it says 'worlds' in the plural form, meaning that there are worlds apart from the human realm. So, what else could these worlds be? They could include the world of Jinn, the world of angels, the world of viruses, entities in another universe, and so on. The other understanding of Alamin is that whatever exists, whether we know it or not. In Surah An-Nahl, another verse is, "And He creates what you do not know." So, we actually do not know what we do not know. It may be mentioned that, 11 years ago, NASA announced the discovery of 715 new planets in our galaxy using Kepler space telescope, four of which were considered potentially habitable. In 2025, NASA discovers a giant super-Earth planet just 154 light-years away, sending a strange, repeating signal. These discoveries point towards the possibilities of extraterrestrial entities.

Surah Ash-Shura, ayat 29, states, 'Wa min ayaatihi khalqu al-samawati wa al-ardi wa



▶ **Photo**
April 2020 footage from the U.S. Department of Defense shows Navy pilots encountering Unidentified Aerial Phenomena (UAP)

mā baththa fihimā min dābbah.' Wa huwa 'alā jam'ihim idhā yashā'u qadīr', meaning, 'And of these signs is the creation of the heavens and earth and what He has dispersed throughout them of creatures.' And He, for gathering them when He wills, is competent. Here, the Arabic word used is 'dābbah', meaning technically 'something moves' and directed towards 'organic/biological beings'. There is another verse in Surah Nur, ayat 45, which states Allah has created every living creature from water. From this understanding of water and the term 'Dabbah', it is clear that Jinn and angels are not included under the category of 'creatures' in the aforementioned verses, since Jinn are composed of smokeless fire and angels are made of light (nur). Therefore, there have to be other living entities who are scattered throughout the heavens and earth, and one might opine that this earth, however, is not our earth or our heaven; rather, it is beyond our earth and heavens. But again, one must know that there are 2 trillion galaxies in the universe with billions and billions of planets. Our universe's observable diameter is 93 billion light-years, and our Milky Way has 200 billion stars. The question comes to

mind as to why Allah SWT created and expanded the universe. We know that Allah does not create anything without purpose. There is always wisdom there. Islamic scholar Ibn Taymiyyah from the 7th century in the Hijri calendar opined that Allah swt has always been creating, as creation flows from His eternal will, not a sudden change or need for external matter. He also meant creation is a continuous, eternal process driven by Allah's inherent nature. Therefore, there may be creations and entities beyond our galaxies and our understanding. But the Quran does not mention whether these creations were created before, after, or in parallel with us.

The human species has existed for about 300,000 years on earth, and we came to know from Hadith that there were approximately 124,000 prophets (including messengers) who came to this earth. So, upon calculation, we discover that mankind received a prophet approximately every 2.4 years. This calculation is very difficult to comprehend given the existing knowledge. One may say that there were periods where more than one prophet came at the same time. In the same way, it can also be said that there were time periods where 500 to 600 years passed between the arrivals of the prophet. More so, Ibn 'Abbas (RA), a renowned Tafsir scholar and Sahaba, was once asked about the verse (Surah At-Talaq, ayat-12), "It is Allah who has created seven heavens and, of the earth, the like of them." He replied, "Seven earths: in every earth is a prophet like your prophet, an Adam like your Adam, a Noah like your Noah, an Abraham like your Abraham, and a Jesus like your Jesus. He was asked further to clarify the verse; however, Ibn 'Abbas (RA) stopped by, saying, 'I can't tell you more; if I do so, you might deny what I say.' While interpreting this verse, it is assumed that there are earths like our own in our universe or other universes and humanlike entities are present on those earths. At the same time, there is a possibility of sending prophets/messengers to those on earth as well by Allah SWT.

In Surah Al Isra, ayat 70, Allah (SWT) says, "Indeed, We honoured the progeny of Adam and bore them across land and sea and

provided them with good things for their sustenance and exalted them above many of our creatures." Here it is clearly evident that Allah SWT has preferred human beings above many created creatures, but not above all creatures. Therefore it is a strong possibility that there are creatures other than us who are exalted over human beings. And also, they may be more intellectual than us.

We know that a human being is created from clay, as mentioned in the Quran. But what we see now is flesh and blood. However, science has found that minerals found in our body are also found in the earth's minerals. This indicates that Clay is a metaphorical concept. In the same way, the Quran speaks about Jinn, which are created from smokeless flame (Mārijin min nār and nār as-samūm). The Arabic phrases, Mārijin min nār and nār as-samūm, have several meanings, which include the fire of poison, scorching wind, intense heat, and penetrating heat. Even in modern understanding, they can refer to plasma or an invisible form of energy. Nevertheless, we learn from the Quran and Hadith that Jinn physically worked during the time of Prophet Sulaiman AS. They could dive fast through the sea and move intensely fast through the air as well. They can manifest as humans, take on various forms, and often appear as creatures such as snakes and dogs. These shape-changing abilities allow them to interact with the physical world. The Quran also speaks about their super-ability to move to a higher space and listen to conversations from angels. So, the fundamental substance of jinn may be some sort of radioactive material. If they were made of some sort of electromagnetic radiation, they would be able to transform themselves into matter and energy, like Einstein's theory $E=mc^2$. Therefore, there are possibilities of certain forms of jinn travelling through the world that cannot be overruled.

From the 20th century to the present, the indescribable phenomena associated with UFOs stress that the entities within the ETV are intelligent and technologically far superior to us. Many of them are seemingly human-like, and others are not. Their



Photo
UAP phenomena, the vast universe, and faith together suggest the possibility of life beyond Earth

movement and avoidance of confrontation with us suggest that they are observing us. However, their real purpose remains unknown or unclear to us as of now. It is found that the Quran & Islamic theology on extraterrestrial entities, vis-à-vis both historical and recent developments in UAP data, are complementary rather than contradictory. It is evident from the discussions that the possibilities of the existence of extraterrestrial entities, human or non-human intelligent beings, cannot be overruled.

It may be noted that some verses in the Quran are 'mutashabihat', meaning

ambiguous and unclear, and require interpretation. The Quran was revealed in classical Arabic, a language rich in metaphor, nuance and subtle linguistic forms that encourage intellectual engagement and spiritual depth to understand clearly. In the end, we can only presume and hope that technological advancement, along with Quranic research, may complement each other in the future to unearth the existing paradox. After all, It is extremely difficult for our tiny brains to comprehend the vastness of the universe and our relative insignificance within it; ultimately, only Allah SWT knows best. 🌌

References

Ergi, Dr Omer.Atilla [Isra Academy]. (2025, August 14). Are Aliens Mentioned in the Qur'an?[video]. YouTube. <https://www.youtube.com/watch?v=d7dRqDAKubM>
Qadhi, Dr. Yasir. [Prevail Islam]. (2025, May 16). Did Alien Exist According to Islam?[Video]. YouTube.<https://www.youtube.com/watch?v=3GBGU03gbVg>

THE VORTEX OF TOMORROW

Flight Lieutenant Nazmul Hasan Anik Chowdhury
Faculty Member, Department of Aerospace Engineering, AAUB

I have always been someone who chases the unknown. A researcher by heart, I've spent most of my life immersed in the world of aviation technology, specifically in the realm of unmanned aerial vehicles (UAVs). And as a young officer from the Bangladesh Air Force, working at the UAV Lab of the Aviation and Aerospace University of Bangladesh (AAUB), I thought I had a pretty good handle on the boundaries of the future. But sometimes, reality has a way of pulling you into the unexpected, and what I experienced one fateful day is something I still can't fully explain.

It all started like any other day. I was at my desk, eyes glued to the screen, tweaking the flight algorithms for a new generation of drones. The work was engrossing—drones that could navigate urban landscapes with a near-perfect understanding of their environment, drones that could save lives in disaster zones. I was deep in thought, lost in the future that I was helping to create, when something... shifted.

The air in the lab thickened, the hum of machines seeming to dull, almost as if they were drawing breath. The lights above flickered once, twice, and then the room began to shake. At first, I thought it was just an electrical glitch—something minor. But the vibration grew stronger, and then a deep rumbling sound filled the space, reverberating through the walls. My heart began to race.

Before I knew what was happening, the floor beneath me cracked. My chair was yanked backward by an unseen force, and papers scattered across my desk. Panic surged through me. I tried to stand, but my body was being pulled toward the centre of the room, as if the air itself was trying to drag me in.

Then, everything went black.

I don't remember how long I was out, but when I opened my eyes again, everything had changed.

I was no longer in the UAV lab. Instead, I was lying on the ground in what seemed like an entirely different

world. My surroundings were bathed in bright sunlight, and I could hear the faint hum of machinery in the distance. I stood up, my legs shaky as I tried to orient myself, but nothing made sense. The city around me was nothing like anything I had seen before.

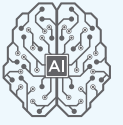
The skyline stretched impossibly high, with towers made of materials that shimmered under the sun. There were no cars on the roads; instead, I saw sleek, floating vehicles gliding silently above the ground. Drones—far larger and more advanced than anything I had worked on—hovered in the sky, their graceful movements controlled by unseen forces. They weren't just for surveillance; they were active participants in every aspect of life.

The buildings were alive in their own way—green walls of plants climbing up their sides, seamlessly integrated with the technology around them. And drones—everywhere I looked, there were drones. They didn't just monitor; they interacted with the world in ways I couldn't even imagine. Some were carrying packages from place to place; others were overseeing construction projects, and a few hovered above parks, ensuring that the plants were healthy and the trees were growing in perfect harmony with the environment.

As I moved through this strange new world, one thing struck me above all else: the profound care taken to protect the environment. These drones, with their incredible power, had been engineered not just for efficiency but for sustainability. I had heard about green technologies, but seeing them in action was something else entirely.

First, I noticed the green propulsion systems that powered every UAV. Gone were the days of noisy, fuel-guzzling engines. These drones operated on clean, renewable energy sources that didn't harm the environment. Their propulsion systems ran smoothly, producing a minimal carbon footprint. They floated silently through the air, their rotors barely audible, as they carried out





their tasks. In a world where environmental protection was paramount, these drones represented the perfect harmony between technology and nature—efficient, powerful, and entirely green.

And then, there was the cross-fan technology. I had always worried about drones disturbing wildlife, about birds being hurt by spinning blades. But in this future world, that was no longer a concern. The drones used an innovative cross-fan system, where the blades were integrated in such a way that they created a soft, constant airflow rather than the usual violent gusts. The result? Birds, small animals, and insects could fly freely without being harmed by the powerful machines. It was a marvel of engineering, an example of how technology had evolved to coexist with nature, not disrupt it.

I couldn't wrap my head around it. Was this some sort of dream? A simulation? Or had I been transported into the future?

My wristwatch gave me the answer. The date read: October 18, 2075. Fifty years had passed since the day I had been working in the lab.

I staggered to my feet, still struggling to grasp what was happening. As I walked through this strange new world, I saw how deeply integrated drones were in every facet of daily life. They weren't just tools; they were protectors. In one corner of the city, I watched as drones hovered over a massive fire, not just watching from above but actively combating the flames with sophisticated firefighting technology. In another area, drones were tending crops, using advanced AI to assess plant health and deliver water or fertiliser with pinpoint accuracy.

But the most striking part of all of this wasn't just the machines—it was the way they interacted with the people. It was as if humanity and technology had merged into a perfect ecosystem. People didn't seem to work as we did—rushing around, struggling to keep up. Instead, they moved with purpose, their lives flowing with an efficiency I could hardly fathom. The drones ensured that everything was in balance—public safety, transportation, and the environment—everything was taken care of.

And then, I saw something that made my blood run cold.

I was standing at the edge of a park when I noticed a group of people gathered around a massive screen in the sky. It was displaying real-time data, showing how drones were monitoring the health of the planet. In the corner of the screen, I saw footage of an entire forest being protected by drones. They weren't just surveying the land; they were actively keeping illegal loggers at bay, preventing overhunting, even maintaining the balance of ecosystems in real-time. These weren't just machines—they were the guardians of this new world.

“ In the corner of the screen, I saw footage of an entire forest being protected by drones. They weren't just surveying the land; they were actively keeping illegal loggers at bay, preventing overhunting, even maintaining the balance of ecosystems in real-time. ”

I couldn't help but feel a strange mix of awe and fear. This was a future I had never imagined—a world where AI and UAVs had become guardians of both the people and the planet. But where did it all start? Could it be that the seeds of this world were planted in the very university I had once attended? Could these technologies—drones, AI, and automation—have begun their journey here?

I didn't have long to dwell on that thought because something happened, something that shook me to my core.

Without warning, the sky above me flickered. The ground rumbled again, more violently this time. The air grew thick, and a powerful force seemed to pull at me. I tried to hold on to anything, but the pull was too strong. I reached out for anything that could anchor me, but before I could react, the world around me began to dissolve into darkness once more.

I woke up with a sharp breath, my body tense. I was back in the lab. The fluorescent lights flickered above me, and the soft hum of machinery filled the air. The screen in front of me displayed the same UAV simulation I had been working on when the strange event began.

I rubbed my eyes and checked my wristwatch. The date was October 18, 2025—exactly the same as it had been before.

Had it all been a dream? A hallucination?

I sat up, heart pounding, trying to make sense of the situation. Everything was exactly the way it had been before. My desk was cluttered with papers, the same simulation running on my computer screen. But my mind couldn't let go of what I had seen—the future, the drones, the AI systems. It was all so vivid, so real.

And then, the door creaked open. It was Alamin, my assistant, calling my name. His face was full of concern, but there was no sign of the strange, futuristic world I had just been in.

“Sir, are you alright? You've been asleep for hours. You were mumbling something... about drones and the future?”

I couldn't answer him. I didn't know if what I had seen was a dream, a vision, or something else entirely. The lines between reality and imagination had blurred, and I was left with a single question: Had I glimpsed the future, or had it all been a hallucination? 🤖

People often consider the horizon to be a line far away that separates the sky from the ground. But at AAUB, I learned that the horizon isn't a line that stops things; it's a start.

BEYOND THE HORIZON MY JOURNEY AT AAUB

Md Ehsanur Rahman (Id: 21024012)

Student, Department of Avionics Engineering, AAUB

There are times in life when a decision quietly changes the direction of your life. One of those times was when I decided to go to Aviation and Aerospace University Bangladesh (AAUB) to study. I came not just to earn a degree but also with a deep fascination for aircraft systems, avionics, and the science behind flight. Long before I stepped foot on campus, the idea that the sky is not a barrier but an invitation inspired me. I didn't know at the time that AAUB was also on a similar path: young, ambitious, and determined to succeed.

My academic journey started at the Dhaka campus, where our first classes taught us the basics of aviation and engineering. In June 2022, we moved to the permanent campus in Lalmonirhat. The campus is a focused environment to study, away from the noise, pollution, and traffic of city life. The dorms were well-planned, with two students sharing each room and having their study desk and other necessary amenities. That structured setting helped me develop discipline, routine, and focus, all of which are important for any engineering student who wants to do well. As a relatively new public university, it has grown in a planned and dynamic way. AAUB consistently improved its lab facilities, often having them ready before the start of a new semester. The university put significant effort into making research easier by giving students free access to labs and encouraging them to start their projects.

The Pico Satellite for Bangladesh project was one of the most important early experiences of my university life. Dr Nazmul Ula, a professor at Loyola Marymount University, initiated the project. From their technical guidance, I learned many new things. They shared practical knowledge about ground station setup, CubeSat design, system development, and mission planning. Through their mentorship, I gained both conceptual understanding and some hands-on experience. I was part of the software team from the beginning and worked closely with talented teammates like Muhtasim Redwan and Benzir Ahmmed. Working with them strengthened my teamwork skills. We discussed ideas, solved technical problems, and supported each other during difficult phases. The experience became even more meaningful when we conducted balloon testing in 2024.

Along with my academic journey, club activities became a significant factor in my university life. I played key roles in two vibrant clubs at AAUB. I was the founding president of the AAUB AI and Robotics Club and vice president (organiser) of the AAUB Cultural Club. The journey with the AAUB AI and Robotics Club officially began on June 23, 2023, with a vision to build a skilled community at the university. Our first flagship program was Circuitry Challenge 1.0. Furthermore, we organised several webinars & seminars with distinguished experts to broaden students' knowledge.



As the club progressed, we launched ROBOVERSE 0.1, AAUB's first-ever inter-university robotics competition. The objective was to provide students with real competitive exposure and structured hands-on experience. Organising the robotics competition has been challenging so far. However, it would not have been possible without the support of Dr Afzal Sir, Samin Sir, and Teethi Ma'am, as well as the dedication of our student volunteers and my panel members. From those experiences, I have learned leadership is about responsibility, coordination, and collective effort.

The AAUB Rover-71 Mars Rover Project was the most defining part of my university life. It began when my friend Tyseer Ninad and I, along with Assistant Professor Samin Rahman Sir and Distinguished Professor Dr Md Afzal Hossain Sir, took the initiative to start building a rover for AAUB. We aimed to participate in international competitions like the Anatolian Rover Challenge and the University Rover Challenge to represent our university and national flag on a global stage while strengthening our research and practical expertise in space science and robotics. The beginning has been challenging so far. During semester breaks, we travelled to Dhaka to develop the rover because of limited hardware access in Lalmonirhat. We worked late nights preparing videos, presentations, and reports for qualifying in the Anatolian Rover Challenge (ARC) 2025. As a new entrant, we achieved 8th position worldwide in the qualification round. Later, due to global & administrative issues, we couldn't participate in the final round. Still, this experience strengthened our confidence and proved our capability.

During this journey, certain people played a vital role in my academic comeback and overall university experience. I would like to sincerely thank Distinguished Professor Air Cdre (Retd) Dr. Md. Afzal Hossain Sir, Air Cdre Dr. Mohammad Akhter Jamil Sir, Dr. Sakir Hossain Sir, Dr. S. M. Sadakatul Bari Sir, and Assistant Professor Samin Rahman Sir for their guidance and support in helping me regain confidence during difficult phases of my academic life. I am also deeply grateful to my close friends Tyseer Ninad and Aliul Hassan Olee. Their friendship made my university life smoother, more diverse, and truly memorable.

People often consider the horizon to be a line far away that separates the sky from the ground. But at AAUB, I learned that the horizon isn't a line that stops things; it's a start. It encourages people to explore, keep going, and be ambitious. It was not just about technical skills but about learning to lead, collaborate, and stay strong during challenges. As time flies, I realise that success is measured not by how high you rise but by how much courage you carry within you. 🌟

AI IN AIR TRAFFIC MANAGEMENT: TRANSFORMING THE FUTURE OF AVIATION

Group Captain Md. Kaisul Hassan, psc
Former Additional Registrar, AAUB

Introduction

The continuous growth of global air traffic has significantly increased the complexity of air traffic management systems. The ever-increasing traffic volume and the need for safe operations in compliance with procedures have increased the workload of air traffic controllers, especially in highly congested airspace. The traditional human-centric system in the control tower had been responsible for managing large volumes of incoming data and providing necessary ATC services until automation was introduced in air traffic management. After the emergence of artificial intelligence (AI) and its associated sub-fields, the ATM system has positioned itself as a strong candidate for benefiting from these technologies. Integration of AI-driven tools, like machine learning and deep learning systems, promises to offer optimised efficiency and safety in air traffic control while substantially reducing the controller's workload. AI-based predictive solutions to complex Air Traffic Management (ATM) systems facilitate the controllers for optimising airspace utilisation, conflict detection, ground

operation management, handling of critical air situations, etc. It reduces the cognitive workload of the operators involved while ensuring safe and efficient ATM. Although the application of AI in ATM is still in its early stages, the opportunities it presents are substantial, with significant potential to drive transformative advancements in the future.

AI in Airspace Optimisation

In May 2021, Alaska Airlines was the first airline to use an AI-based platform called "Flyways" to find and suggest more efficient and environmentally friendly flight paths (Narayanan, 2023). AI-based systems for managing traffic flow use historical and real-time data to predict air traffic demand and identify potential congestion points. It can recommend rerouting options and departure sequences to reduce delays and improve airspace capacity. The SESAR (Single European Sky ATM Research) project is a technological initiative aiming to modernise Europe's air and ground ATMs. Under this initiative, ASTRA, an AI-enabled algorithm, is envisaged to identify vulnerable tactical flow management positions (such as Area Control Centre or ACC) for traffic

congestion at least 1 hour in advance. It can also provide optimal solutions considering appropriate flight trajectory and efficient fuel consumption (SESAR joint undertaking, 2026).

A much-discussed technological concept in present aviation is the Trajectory-Based Operation (TBO). The concept is aimed at enhancing trajectory predictability in different phases of the flight in terms of latitude, longitude, altitude and time. By using AI models and continuously sharing this four-dimensional trajectory data among airspace users, TBO can improve airspace capacity, optimise traffic flow, and reduce controller workload. According to figures presented at the Global TBO Symposium held in June 2024, in Europe, it should presumably increase sector capacity by 100%, increase in flights per hour in many sectors from 45 to 97 flights and reduce the average working time to manage 100 flights by 50% (Eurocontrol, 2026).

AI in Decision Support Systems

The challenges for air traffic controllers have increased in both operational and cognitive areas as global air traffic volume has increased substantially. Decision support tools with AI software can assist air traffic controllers by prioritising alerts, managing workloads, and providing actionable recommendations during complex scenarios. It assists to process large amounts of real-time information from multiple sources, make rapid decisions, and coordinate continuously with pilots and adjacent control sectors. AI algorithms continuously monitor aircraft flight paths to detect potential conflicts earlier than traditional systems. In a complex scenario, it can also consider multiple constraints such as fuel efficiency,

weather, and safety margins. Taking all factors into consideration, the AI model is capable of providing optimal advisory solutions to operators for handling an unpredictable situation arising from adverse weather, equipment failures, or human error.

Speech recognition for air traffic controllers and pilots remains challenging because of variations in phraseology, diverse English accents, and noise or interference in communication channels. The HAAWAI (Highly Automated Air Traffic Controller Workstations with Artificial Intelligence Integration) project has developed new speech recognition software based on deep neural networks. Combining voice with radar data enables the system to improve at the semantic level. Machine learning techniques were also applied to develop a Readback Error Detection Assistant (REDA). Readback errors occur when a pilot incorrectly repeats an air traffic controller's clearance. The REDA automatically identifies such discrepancies and generates alerts when readback errors occur. (CORDIS, 2022)

Predictive Weather Assessment

Weather-related disruption has consequences not only in the air but also on ground operations. It often creates delays in departure and arrival sequences in the airports. Historical climate data of a specific geographical area can be used to train the AI machine learning algorithm for predicting the weather of that area (A. Ajinaa, 2023). AI systems can analyse meteorological data to forecast upcoming weather phenomena related to air operations. This in turn enables the operators to take proactive measures, such as rerouting flights, adjusting flight schedules, or planning for aircraft parking. Although errors in prediction cannot be eliminated fully, AI systems can still attain more reliable forecasting results compared to traditional forecasting methods.

Airport Surface Operations

Airport surface operation is always a complex and dynamic scenario. AI plays an increasingly important role in enhancing efficiency and safety here. AI-based systems can analyse real-time data from

surveillance cameras, weather reports and flight schedules and detect possible choking phases of the operations. This allows the operators to re-plan aircraft taxi routing, gate assignment, runway usage, etc. to optimise the available ATS facilities. In addition, AI supports surface safety by detecting runway incursions and abnormal movement patterns (Ibrahim, 2024). With the integration of AI in airport surface operations, it becomes more coordinated, resilient, and sustainable airport management. At present, an AI-based camera system called "Seer" is used at Frankfurt Airport by the Fraport operator and Lufthansa Airlines in collaboration to optimise ground operations and aircraft handling.

Recently, integration of AI-powered robotic systems has brought significant upgradation in airport management. Along with the standard airport management system, these robots are performing non-safety-critical tasks side by side. They are capable of performing passenger assistance, security operations, baggage handling, cleaning services and ground support activities. In Heathrow and Changi airports, automated DollyTug robots are transporting luggage between terminals and aircraft. Kansai International Airport in Japan has deployed police and patrol robots to enhance security through 360-degree surveillance camera systems.

Challenges and Limitations

Although AI has vast and promising capabilities in ATM systems, the implementation process requires regulatory approval to ensure reliability and trustworthiness. There are few challenges for safe and efficient system deployment, like data validation, system endorsement, cybersecurity threats, etc. To eliminate the challenges, it needs rigorous testing and certification processes by a competent authority before any application of an AI model. Moreover, ethical issues associated with automation cannot be overlooked. It is essential to define necessary protocols for apportionment of accountability in the event of system failures or incidents (Flight Data Technology, 2025).

In the realm of technological advancement, predisposition against machine algorithms

is vividly noticeable, particularly when the decisions involve significant consequences. In such a dichotomy, human intuition tends to be preferable to software formulas in the decision-making process (Kahneman, 2011). Therefore, while AI provides substantial benefits, the human role remains critical in aviation, especially for air traffic controlling. Controllers' experience enables them to manage unexpected situations by applying judgement and strong situational awareness. Their ability to integrate diverse information within a broader operational context is essential for safe and effective air traffic management. Therefore, keeping a human-in-the-loop approach is essential for safety, accountability, and resilience in automated ATM environments.

Future Scope

The present AI application in aviation is at the beginning stage in contrast with the enormous opportunity that it offers. If the challenges can be dealt with through international collaboration, standardisation, and continuous research, it is possible to realise the full potential of AI in global air traffic management. Great initiatives are already visible, like the SESAR programme and the FAA's NextGen initiative for using AI to develop more intelligent, integrated, and environmentally sustainable ATM systems. With further proliferation of AI technologies, we can expect more autonomous and data-driven airspace operations in the future. Soon it is likely to integrate unmanned aerial vehicles (UAVs) with urban commercial carriers in a seamless collaborative airspace.

Conclusion

The integration of AI into global ATM systems is transforming the future of aviation. However, it needs careful consideration of safety, trust, interoperability and regulatory supervision to extract optimum benefits from AI applications. Human operators like controllers, pilots, and supervisors remain a critical component of the system. Their contextual knowledge and expertise may not be fully replicated by AI. However, with the enormous possibilities, AI is set to become an essential tool for managing the growing complexity of global airspace. 🌍

HOMEBOUND WINGS

Mushfiq Al Arafa
Lecturer, Department of Aerospace Engineering, AAUB

Aarif slowly woke up as the aircraft began its descent to land. As his wristwatch ticked, his chest tightened with emotions he could not express. Outside the window, the morning sky glowed softly, and rivers wound their way through the green landscape. He had flown over many countries before, but this view carried a different feeling. This time it was not just another destination, but his motherland.

Aarif had always held a clear vision for his studies, gradually earning an aerospace degree abroad, working in advanced research labs, and

contributing to projects that pushed the boundaries of engineering. Every step had been pre-calculated, almost like an engineering problem.

Yet somewhere along the way, life redirected him toward his roots. He once believed that the opportunity to return home had permanently faded, but with time, he slowly realised that there were still many doors.

However, returning home was never simple. Friends and family often warned him to rethink his decision, reminding him of the uncertainties that awaited. Yet Aarif believed a quiet truth: not all plans unfold the way we

expect, and occasionally, they unfold better. He observed and firmly believed that humans plan with logic, but the Almighty plans with wisdom. What once felt like a detour now felt like guidance.

After months of interviews and repeated attempts, Aarif finally secured a faculty position at a prestigious university in Bangladesh. The laboratory equipment was limited and the funding was modest, but the ambition of the team was immense. Alongside him, there were other engineers too, who were honest, sincere, and ambitious. They had also returned from distant lands, bringing knowledge from different parts of the world. Together, they worked on indigenous aerospace systems to support Bangladesh's defence technology—something the nation needed more than it realised.

The journey began from scratch and was never smooth. Sleepless nights became routine, and the initial prototypes failed to achieve the expected performance. Simulations contradicted reality, and at times it felt as though the project was going nowhere. Exhaustion whispered doubts into his mind, but every challenge strengthened his belief that he was precisely where he was meant to be. One evening by the Teesta River, their drone lifted steadily into the sky, cutting cleanly through the wind. Aarif watched in silence, gratitude washing over him. This success was not just theirs; it was a sign that they had taken Bangladesh one step forward.

Days later, during a student demonstration, a freshman asked,

"Sir, can aerospace research really grow in Bangladesh?"

"Yes," he smiled and said softly, "when we work sincerely and trust that the Almighty's plan is far better than the ones we design ourselves."

As years passed, Aarif understood that coming home had never been the end of his journey. It was the beginning of something special. It was the beginning of service, faith, and a future where Bangladesh would rise, one wing at a time. 🌍



HARNESSING THE POWER OF DATA ANALYTICS IN ENHANCING AVIATION SAFETY: A NEW ERA OF RISK MANAGEMENT

Wing Commander Md Anisuzzaman (ID: 23016009, MBA)

Student, Department of Aviation Operation Management, AAUB

The future of aviation safety worldwide is evolving from conventional investigation techniques toward data-driven risk management, and in this context, analytics plays a vital role. The growing aviation sector in Bangladesh and institutions like the Aviation and Aerospace University of Bangladesh (AAUB) must embrace and adopt such technology to ensure a safe and efficient aviation industry.

Traditionally, aviation safety has relied heavily on human-based techniques and measures, including rigorous pilot training programmes, standardised air traffic control, and routine maintenance inspections. Although over the years these techniques and measures have been supplemented by technological innovations such as radar systems, flight data recorders, and enhanced weather forecasting, accidents and near-accidents still occur in the industry. The main reason for this persistence of accidents and near-accidents in spite of all the advancements that have been made in the industry is that aviation systems today are too coupled and complex; hence, data analysis has become a supplementary technique

that can be used by organisations to address accidents and near-accidents that exist in the industry today. (Harrison, 2018)

Data Analytics as a Core Safety Tool

Data analysis has been applied in the aviation industry to examine large volumes of data (sensor data, maintenance records, flight paths, and weather patterns) using statistical and computational methods. The ability to evaluate all of these together rather than individually helps identify new trends and patterns, ultimately enabling a much better risk assessment.

Currently, safety management primarily employs data analysis through predictive maintenance, flight data analysis, accident investigation, and enhanced weather analysis. While each individual application provides a unique contribution to safety management, when combined together, all four applications can create a much more holistic approach to safety management for commercial airlines, regulatory agencies, and academic institutions such as AAUB.



Photo
Data-driven analytics is shaping a safer, more efficient future for modern aviation systems worldwide

Predictive Maintenance and Reliability Enhancement

Predictive maintenance, for instance, relies on constant flows of data from sensors monitoring an aircraft's engines, hydraulic systems, avionics, and structural components. Modern aircraft produce enormous amounts of this type of data, which can be transmitted to the ground and analysed using predictive analyses to detect subtle changes.

Rather than relying on the traditional fixed-interval maintenance routine, airlines can now leverage these models to perform repairs or replacements when early warning signs emerge, such as unusual vibration patterns, temperature trends, or pressure readings. This will minimise the risk of technical malfunctions during flights and unscheduled aircraft downtime, and it will help airlines better focus their maintenance efforts on the most critical areas. There are several benefits of predictive maintenance, including cost savings, enhanced safety, and more efficient aircraft management (Eckhardt & McMullen, 2019).

In the case of Bangladeshi Airlines, predictive maintenance is very advantageous for meeting needs in a

resource-scarce environment. The graduates of AAUB in engineering and aviation management can be very helpful in that case by leveraging their domain expertise alongside data analysis and monitoring capabilities.

Flight Data Monitoring and Operational Safety

Flight data monitoring (FDM), also known as flight operations quality assurance (FOQA), is the collection of flight data on factors such as altitude, airspeed, pitch, roll, and engine performance. By analysing all the flight data, certain characteristics are identified that may have contributed to past accidents.

These characteristics may include unstable landings, excessive roll, and failure to maintain the designated flight altitude. By identifying such characteristics, an airline may be able to improve its standard procedures, develop training programs to address specific issues using simulators, and, in some cases, change flight routes or approaches to landings. Flight parameters may be monitored in real time, and in case of a significant deviation, action may be initiated while in flight. (Singh & Soni, 2020)

In the Bangladeshi scenario, the widespread application of effective Flight Data Monitoring (FDM) programmes by domestic and regional airlines would be a major move towards improving safety management and promoting a data-driven safety culture. AAUB can contribute to this process by including FDM concepts, examples, and approaches in its educational programmes, thus enabling its graduates to help in this process.

Big Data, Machine Learning, and Accident Investigation

In case of accidents or serious incidents, large volumes of data from flight recorders, cockpit voice recorders, radar systems, maintenance systems, and weather systems must be analysed. Conventional analysis techniques depend on human analysts' expertise in interpreting data, but the volume and complexity of modern data are increasingly difficult to analyse manually.

Machine learning and analytics provide techniques to uncover correlations, temporal relationships, and causal links that may not be apparent to human analysts. For instance, machine learning algorithms can be used to analyse past incidents to determine combinations of environmental factors, aircraft status, and crew behaviour that often precede certain types of incidents. This information can be used to distinguish between isolated incidents and systemic weaknesses in procedures, training, or design. (Wang et al., 2017)

Regulators like the Civil Aviation Authority of Bangladesh (CAAB) can improve the quality and speed of investigations and help design better safety regulations through the application of big data and machine learning. There can be cooperation among CAAB, airlines, and educational institutions like AAUB, allowing students and researchers to assist in the design of better investigation support systems and safety data analysis systems.

Real-Time Weather Analytics and Flight Planning

Weather is one of the key areas that creates operational risk in flight operations,



especially in areas where thunderstorms, heavy rain, or tropical storms are prevalent. Although forecasts and radar-based observations are essential in providing key weather-related information to airlines, such data does not always come with detailed analysis for the entire flight period. Weather analytics make use of satellite images, radar, numerical models, and in-flight reports to offer detailed forecasts on turbulence, wind shear, icing, or storm development. Weather analytics can be employed to create flight plans that avoid dangerous weather while consuming the least amount of fuel possible. (Zhu et al., 2019)

Bangladesh, with its monsoon season and convective weather conditions, is one area that will greatly benefit from the use of such technology in flight operations. This will be a rich source of learning material in AAUB's courses on meteorology, navigation, and airline operations.

Opportunities and Responsibilities for Bangladesh and AAUB

Bangladesh's aviation industry has experienced tremendous growth recently, driven by increased domestic, international, and cargo operations. This growth requires a corresponding increase in safety management, regulations, and technology. CAAB's drive to bring air traffic management into the 21st century and align regulations with global norms is a positive step toward integrating analytics-based safety management at a national level.

AAUB has a strategic role in this context, given its specialty in aviation and aerospace education. In this regard, it can incorporate data analytics into its safety management curriculum and include case studies in its programmes in aerospace engineering, aviation management, and air traffic management to prepare graduates capable of designing and operating analytical safety systems. Collaborative research on flight data analysis, predictive maintenance models, and weather-impact studies can further reinforce this connection.

Pros and Cons of Safety Based on Data

Using data analytics in aviation safety management provides many advantages. For example, companies will gain increased situational awareness, improved decision-making capability, and greater operating efficiency. In addition, there will likely

“ Dealing with different aircraft types requires developing appropriate standards, which would need a lot of IT infrastructure. ”

be a significant cost reduction from unscheduled maintenance and operational interruptions. This will assist in achieving both environmental and customer service objectives.

However, certain factors must be addressed to fully harness the benefits.

First and foremost, there have to be appropriate privacy and security arrangements when dealing with confidential information. Second, dealing with different aircraft types requires developing appropriate standards, which would need a lot of IT infrastructure. Thirdly, the cost factor may act as a constraint for small organisations to adopt advanced analytics tools. Fourthly, an appropriate safety culture has to be established to avoid a culture of 'blame'.

Conclusion

Data analytics is transforming how aviation organisations identify, evaluate, and prevent or mitigate safety risks, thereby moving the entire industry toward a more predictive, systemic approach to safety. For Bangladesh, this transformation presents both a challenge and an opportunity; as traffic increases and new infrastructure develops, data-driven safety tools can ensure that growth does not come at the expense of safety.

AAUB, as a dedicated aviation and aerospace university, is well-positioned to lead in this area by producing graduates with knowledge and experience in both the technical aspects of aviation systems and modern analytical techniques. By promoting research, education, and collaborative work on data-driven safety, AAUB can contribute to a safer, more resilient aviation sector in Bangladesh and to global efforts to use analytics to improve aviation safety. 🌐

References

- Eckhardt, A., & McMullen, M. (2019). Predictive maintenance in aviation: Improving safety through data-driven strategies. *Aerospace Engineering Journal*, 29(3), 45-58.
- Harrison, M. (2018). The evolution of aviation safety: An overview of technological advances. *Aviation Safety Review*, 12(1), 34-48.
- Singh, R., & Soni, S. (2020). Flight data monitoring and its impact on aviation safety. *Journal of Air Traffic Management*, 5(2), 73-85.
- Wang, Y., Zhou, X., & Li, T. (2017). Machine learning in aviation accident investigations: A new paradigm for safety management. *International Journal of Aerospace Safety*, 8(4), 113-127.
- Zhu, H., Li, Y., & Zhang, M. (2019). Weather analytics in aviation: Enhancing safety and operational efficiency. *Journal of Meteorology and Aviation*, 27(3), 215-230.

MOON MISSIONS THE SCIENCE BEHIND DIFFERENT TRAVEL TIMES

Group Captain Saleh Ahmed Khan, psc

Former Chairman

Department of Aviation Operation Management, AAUB

The Moon has been a source of wonder since the dawn of humanity, sparking countless myths that endured well into the nineteenth century. While the invention of the telescope provided our first clear glimpse of the lunar surface, the true secrets of our celestial neighbour only began to unfold when humans entered its orbit and eventually set foot on its soil. While only the United States has sent humans to the lunar surface, many nations have since launched robotic missions to explore the Moon. Recently, the global lunar landscape has expanded to include emerging space nations; notably, on April 8, 2025, Bangladesh officially signed the Artemis Accords, becoming the 54th nation to join the NASA-led coalition for peaceful lunar exploration. Interestingly, the duration of these journeys varies wildly. While the Apollo missions reached the Moon in roughly three days, some modern robotic probes have taken several months or even over a year to reach the same destination. This paper will investigate the factors—ranging from fuel efficiency and engine types to complex orbital mechanics—that dictate how long it takes to bridge the gap between Earth and the Moon.

Selecting the most efficient path to the Moon is a complex balancing act where time is often traded for technical or financial economy. While the physics of gravity remain constant, the "speed limit" of a lunar mission is dictated by the specific needs of the payload and the capabilities of the hardware. For crewed missions, speed is a safety requirement to minimise life-support consumption and radiation exposure. For robotic explorers, however, time is a flexible variable that can be extended to accommodate lower-cost rockets or highly efficient, low-thrust engines. The journey is a complex balance dictated by mission priorities, engineering constraints, and the fundamental laws of orbital mechanics. By examining the interplay of several core factors—mission objectives, spacecraft design, propulsion systems, trajectory selection, and orbital manoeuvres—we can understand why there is no single path to our celestial neighbour, but rather a spectrum of journeys tailored to specific goals.

Mission Objectives

A mission's primary goal is the dominant factor. Crewed missions (e.g., Apollo, Artemis) prioritise speed for astronaut safety and consumables, using direct, high-energy 3-day trajectories. Uncrewed science missions can afford longer, low-energy routes, trading time for greater payload capacity or fuel savings. For example, India's Chandrayaan-3 followed a multi-week trajectory to efficiently deliver a lander and rover to the lunar South Pole. This contrasts with technology demonstrators like ESA's SMART-1, which used an ultra-efficient but very slow solar-electric propulsion system, taking over a year to spiral from Earth orbit to the Moon. Similarly, test missions for new orbits (like CAPSTONE) also use slow, efficient paths to validate navigation with reduced propulsion demands in spacecraft design.

Propulsion Systems

The propulsion type defines the energy profile. Powerful chemical rockets, like those used by Apollo, provide high thrust for short, direct injection burns, enabling rapid three-day trajectories. In contrast, high-efficiency, low-thrust systems like solar-electric propulsion (SEP) used by ESA's SMART-1 cannot perform quick TLI burns. Instead, they apply continuous, gentle thrust over months to gradually raise their orbit, achieving the same final energy with far less fuel but at the cost of a 13-month journey. Modern missions like Chandrayaan-3 often use a hybrid approach: a traditional chemical propulsion module performs the main orbital manoeuvres but with a series of efficient burns designed to maximise payload over speed.

A ballistic lunar transfer (BLT) is a long, fuel-efficient scenic route. Missions like Chandrayaan-3 used this method, taking weeks but saving immense fuel to carry a heavier lander



Photo
Apollo-11, Chandrayaan-3 and SMART-1

Trajectory

Getting to the Moon is not just about speed; it is about choosing the right "road" based on the needs. A direct transfer is like taking a high-speed highway—the path used by Apollo, employing a powerful, direct injection to reach the Moon in just three days. On the other hand, a ballistic lunar transfer (BLT) is a long, fuel-efficient scenic route. Missions like Chandrayaan-3 used this method, taking weeks but saving immense fuel to carry a heavier lander. An even more extreme example is SMART-1, which used a complex spiral trajectory enabled by its low-thrust engine, turning its journey into a multi-month orbit-raising campaign.

Orbital Manoeuvres

The sequence and scale of propulsion burns directly schedule the trip. A single, powerful Trans-Lunar Injection (TLI) burn from a rocket's upper stage, as executed perfectly by the Apollo missions' Saturn V, commits

the spacecraft to a fast, direct route. Alternatively, a series of smaller perigee burns can be used. This was the strategy for Chandrayaan-3, which performed multiple engine firings at perigee to methodically raise its Earth orbit before its final lunar injection. The most gradual approach is exemplified by SMART-1, whose solar-electric engine performed near-continuous, tiny manoeuvres over thousands of orbits to spiral its way to the Moon.

Bangladesh's Strategic Leap to the Moon

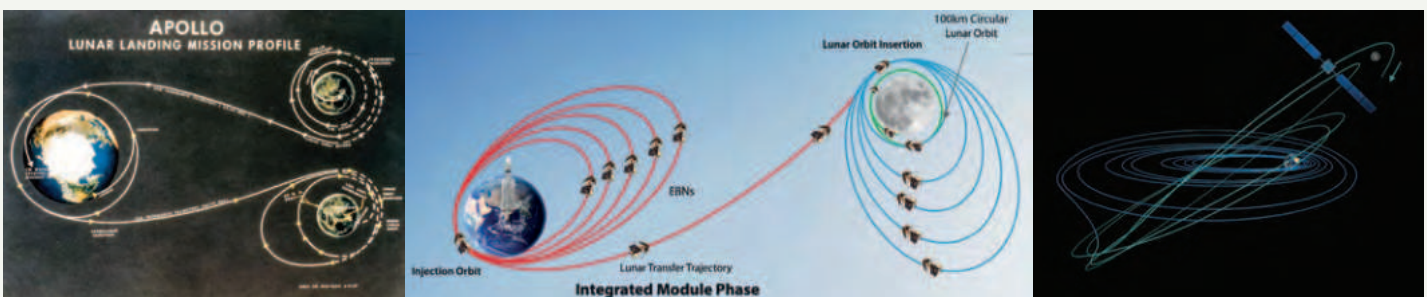
Bangladesh's journey from the Bangabandhu-1 satellite to a potential lunar mission represents a bold step for a growing space nation. For a first mission, the most practical approach is a robotic orbiter or lander rather than a high-speed crewed craft. By following a "smart engineering" model—similar to India's Chandrayaan missions—Bangladesh could use smaller, more affordable rockets to launch into a

low-energy trajectory. This path uses a series of fuel-efficient engine burns over several weeks to gradually reach the Moon. While slower, this strategy maximises the scientific gear the craft can carry and allows valuable time for system checks, building the national expertise needed to firmly establish Bangladesh's presence in deep space.

Conclusion

The diversity of lunar mission travel times reflects the interplay of physics, engineering, and mission priorities. Crewed missions such as Apollo, which reached the Moon in about three days using powerful chemical rockets, highlight the need for speed to protect astronauts and minimise consumables. Robotic missions prioritise efficiency over speed: Chandrayaan-3 used staged manoeuvres over several weeks to save fuel; CAPSTONE took 4.5 months via a ballistic transfer to reach its unique orbit; and SMART-1 utilised solar-electric propulsion to slowly spiral toward the Moon over 13 months. As Bangladesh enters this arena through the Artemis Accords, its path will likely be defined by these same trade-offs. By choosing efficient, longer-duration trajectories over sheer power, emerging space nations can participate in the lunar economy sustainably. The Moon remains a proving ground where diverse strategies converge, proving that travel time is not merely a constraint but a powerful design tool tailored to the specific scientific and economic goals of the mission. The Moon, thus, remains a proving ground where diverse strategies converge, each revealing new ways humanity adapts orbital mechanics to purpose.

Photo
Flight trajectory of Apollo-11, Chandrayaan-3 and





ROCKETS TO REALITIES— WHERE AVIATION MEETS THE SPACE ECONOMY

Assistant Professor Dr. Hosnay Nasrin
Chairman
Department of Aviation Operation Management, AAUB

Space is not just a frontier for exploration; it is a cornerstone of the national economy and security. The space age is facilitated by technological advancements, rendering the production and deployment of satellites in Low Earth Orbit (LEO) more economical than before, which encompasses satellite-based communications, earth observation, navigation, space tourism, in-orbit services and space-derived data analytics. The “new space economy” refers to a shift from state-controlled, cost-plus space activities to a market-orientated ecosystem driven by private investment, competition, collaboration and downstream applications. On the other hand, aviation ponders how to link cities, nations, and markets within Earth’s atmosphere. Aviation has transitioned from being only peripheral to space activities,

encompassing launch systems, manufacturing procedures, regulatory frameworks, and labour competencies. The advent of a modern space economy—marked by commercialisation, private-sector dominance, and technological convergence—has positioned aviation at the core of space development. Therefore, this article examines how aviation intersects with and enables the space economy, analysing industrial convergence, regulatory challenges, and economic implications. The article also highlights the emergence of the space economy in Bangladesh and observes that the future of the space economy cannot be implicit without recognising aviation’s expanding role, as both act like an enabler and beneficiary of space innovation.

The New Space Economy and Connection with Aviation

The new global space economy is booming, hitting around \$613 billion in 2024 and \$646.90 billion in 2025, driven by commercial growth in satellites, connectivity, earth observation, and new ventures, with projections aiming for \$1403.49 billion by 2032—growing at a compound annual growth rate (CAGR) of 11.7% from 2025 to 2032 and reaching over \$1.8 trillion by 2035 (Source: Space Foundation Press Releases).

The aviation market anticipates a series of benefits from the implementation of new space-based initiatives. Particularly, the global provision of communication and surveillance services is expected to enhance the safety and efficiency of air traffic. North America and Europe have the largest and second-largest space economies in the world, with market shares of over 50% & 20%,

The global **space industry** has grown into a **trillion-dollar** market with over **11,000 satellites** in earth orbit



respectively. The space economy of the Asia-Pacific region is growing rapidly with a CAGR of over 10%. China is swiftly evolving its space capabilities, driving this expansion. Other nations in the Asia-Pacific region, such as India, Japan, and South Korea, are significantly investing in the space industry as well.

The space economy intricately links to the aviation and aerospace sectors, primarily through shared technological requirements, infrastructure needs, and regulatory frameworks. Advancement in aviation infrastructure, such as expanded airports, improved air cargo systems, etc., stimulates general economic activities, which in turn raises investment capacity for forward-looking sectors like space systems. An improved aviation sector advances logistical capabilities for aerospace components and functions as a centre for regional aerospace operations. Aviation has historically been at the forefront of utilising space-based services, enhancing safety, efficiency, and connection, and therefore generating economic value. Key applications include navigation and surveillance, communications, meteorological forecasting & monitoring and emergency response to enhance search-and-rescue operations and improve disaster management. Aviation infrastructure serves as a gateway to space and transforms into multifunctional aerospace centers. Global Navigation Satellite Systems (GNSS) are crucial to modern aviation. Satellite-based navigation and aviation services boost precise approaches, reduce fuel consumption and improve safety in adversarial weather conditions. Earth observation satellites provide essential data for aviation, including weather forecasts, volcanic ash identification and climate surveillance. The integration of aviation and space is also transforming industrial supply chains. The differences between aviation and astronautics are diminishing due to the emergence of commercial space tourism (e.g., Virgin Galactic and Blue Origin) and the progression of reusable rockets, necessitating extensive collaboration in legislation, operations and technology. Pilots, engineers, air traffic controllers and

“North America and Europe have the largest and second-largest space economies in the world, with market shares of over 50% & 20%, respectively”

aviation maintenance professionals possess competencies that are directly relevant to space operations. Educational institutions are responding by offering interdisciplinary aerospace programmes that reflect the realities of a converged aviation and space industry. The cross-sector application enhances national GDP, generates employment and facilitates global trade, and serves as a substantial economic engine. Therefore, aviation and space are both strategic sectors, with implications for national security, sovereignty, and global encouragement.

The Emergence of Space Economy in Bangladesh

The global space industry has grown into a trillion-dollar market with over 11,000 satellites in earth orbit. In the recent era, the USA, Russia, France, Japan, China, the UK, India, Israel, Iran, Canada, Italy, South Korea, and the European Union have both rocket and satellite manufacturing capabilities. Bangladesh holds significant potential and is also actively exploring ways to enter the global space economy. It has stepped forward to develop a rocket manufacturing and launch station, a satellite manufacturing industry with an Assembly, Integration, and Test (AIT) laboratory, and a space industrial park. The Bangladesh Space Research and Remote Sensing Organisation (SPARRSO) has signed an agreement with Development

Design Consultants Limited to conduct the feasibility study at a cost of about Tk1.35 crore in this regard. Bangladesh's first satellite (Bangladesh-1, launched in 2018) has already supported broadcasting and data services. Students from BRAC University, in collaboration with SPARRSO and Kyushu Institute of Technology (Kyutech), developed Bangladesh's first nanosatellite, BRAC Onnesha. Bangladesh signed the Artemis Accords with NASA in April 2025, becoming the 54th signatory to this framework of civil, peaceful space exploration cooperation. This agreement offers access to non-military technology collaborations, scientific partnerships, training opportunities, and potential research exchanges with global space agencies. Future satellites and potential indigenous satellite manufacturing would expand capabilities in communications, earth monitoring (e.g., agriculture and disaster prediction), navigation, and national security. Space industrial parks are envisioned to attract investment, create jobs in engineering and technology, and build a skilled workforce—critical elements for any advanced national technology economy. The initiatives aim to build long-term space capability, strengthen self-reliance, boost foreign revenue, develop skilled talent, raise Bangladesh's profile in global space science, and tap into the emerging trillion-dollar space economy.

The Bangladesh Air Force's involvement in non-military space programmes underscores the twofold civilian-military benefits of an integrated aviation-space strategy. Joint aerospace and space investments improve sovereign capabilities for defence surveillance, navigation, and secure communications. Several universities and student teams are increasingly engaging in space-orientated projects, including small satellite design, payload development studies, and robotics related to planetary exploration. The educational activities and research & development initiatives at the Aviation and Aerospace University, Bangladesh, support long-term workforce development, bridging skill gaps that are essential for both aviation and space hardware and systems



engineering. This university also contributes to building national capacity for building satellites, launching aerial vehicles or avionics systems. The Memorandum of Understanding signed on December 21, 2025, between the Bangladesh Air Force and the Aviation and Aerospace University, Bangladesh, formalises cooperation in training, research, and development. This embraces drone and aerospace platform training and joint R&D activities—core foundations for building aerospace (including space) competence.

Conclusion

Notwithstanding its potential, the integration of aviation and the space economy encounters numerous obstacles. Regulatory fragmentation, elevated capital expenditures, environmental issues, and space debris management present substantial risks in Bangladesh, which could hinder the growth and sustainability of the aviation and space economy in the country. The aviation and space sectors necessitate advanced engineering expertise that is presently scarce in Bangladesh. Substantial funding is essential for constructing and launching facilities, establishing satellite production, and developing research & development infrastructure. The environmental impact of launches and high-altitude flight raises sustainability concerns that require resolution through innovation and policy alignment. Integrating space launches with congested airspace requires advanced national regulatory frameworks.

In Bangladesh, the space economy and aviation growth are not distinct policy domains; they are intricately linked through technology, workforce development, infrastructure, and national strategy. Progress in aviation yields economic benefits and enhanced connectivity as well as vital human resources and technical infrastructure for a prospective space industry. Simultaneously, space capabilities—particularly in satellites and remote sensing—enhance aviation operations and contribute to overall economic development. Dialogues with

NASA and bilateral aerospace collaboration may facilitate the expeditious transfer of technology and the enhancement of capabilities. Formal collaborations that foster expertise and hands-on experience in aerospace platforms will be crucial for further advancement. National rules and regulatory frameworks governing airspace utilisation, safety standards, and aeronautical engineering research directly impact the integration of space launch activities within Bangladesh's comprehensive aviation system. The expansion of airports, the modernisation of air traffic control, and aviation safety systems all provide foundational infrastructure that a space economy could leverage.

The emerging space industry is not a standalone domain; it fundamentally intertwines with the technology, infrastructure, and institutional expertise of aviation. Aviation serves as the operational

foundation for commercial space activities, encompassing launch systems, production, regulation, and workforce development. As rockets become realities of everyday economic life, the intersection of aviation and space will influence global connectivity, economic expansion, and humanity's engagement with the earth's atmosphere and outer space. Understanding this confluence is crucial for governments, industry leaders, and researchers who aim to manage and capitalise on the potential of the aerospace era. The demarcation between aviation and space will continue to diminish. Notions like hypersonic point-to-point travel, high-altitude platforms, and regular suborbital flights indicate a future where "aerospace" evolves into a really integrated field. In the future, aviation will not only accommodate the space economy but will also play a pivotal role in shaping it. 🌍

References

1. Organisation for Economic Co-operation and Development (OECD). (2023). The space economy in figures: How space contributes to the global economy. OECD Publishing.
2. International Civil Aviation Organization. (2022). Aviation and space: Towards integrated airspace management (Working paper). ICAO.
3. Federal Aviation Administration. (2024). Commercial space transportation annual compendium. U.S. Department of Transportation.
4. European Space Agency. (2023). Space economy and commercialization trends. ESA Publications.
5. Pricewaterhouse Coopers. (2021). Space: The \$1 trillion opportunity. PwC.
6. International Air Transport Association. (2022). Aviation benefits from satellite-based technologies. IATA.
7. United Nations Office for Outer Space Affairs. (2021). Space activities and sustainable development. United Nations.
8. National Academies of Sciences, Engineering, and Medicine. (2020). Commercial space and aviation safety frameworks. National Academies Press.
9. The Business Standard. (2025, December 15). Aiming for the space economy: Bangladesh plans rockets, satellites, and a space industrial park. <https://www.tbsnews.net/economy/aiming-space-economy-bangladesh-plans-rockets-satellites-and-space-industrial-park-1310051>
10. Coherent Market Insights. (2024). Global space economy market report. <https://www.coherentmi.com/industry-reports/global-space-economy-market>

UNMANNED BUT UNREGULATED? EXAMINING BANGLADESH'S DRONE LAW AND NATIONAL AIRSPACE

Sharara Mehnaz Khan
Lecturer, Department of Aviation and Space Law, AAUB

The use of unmanned aerial vehicles (UAVs), popularly known as drones, has grown rapidly in Bangladesh over the past decade. From media coverage and academic research to surveying, agriculture, and recreational photography, drones are increasingly visible in the country's skies. While this technological growth offers significant opportunities, it also raises serious legal questions regarding safety, security, privacy, and effective regulation. The central concern remains whether Bangladesh's existing legal framework can effectively govern the expanding use of drones in its national airspace.

Legal Status of Drones in Bangladesh

In Bangladesh, drone operations are primarily regulated by the Civil Aviation Authority of Bangladesh (CAAB). Rather than a standalone drone law enacted by Parliament, drone governance currently relies on administrative guidelines, circulars, and permissions issued by CAAB under its general authority to regulate civil aviation and national airspace.

According to existing regulations, drone operators must obtain prior approval from CAAB and, often, clearance from law enforcement and security agencies. Restrictions apply particularly to flights near airports, military installations, government buildings, and other sensitive locations. Despite these rules, drone usage remains

widespread, and unauthorised operations continue to pose regulatory challenges.

Safety and Airspace Management Concerns

Safety is the most pressing issue surrounding drone operations in Bangladesh. Unauthorised drone flights near Hazrat Shahjalal International Airport and other domestic airports have raised concerns about potential collisions with manned aircraft. Even small drones can cause serious damage to aircraft engines or windscreens during takeoff and landing.

Bangladesh's airspace management system was designed for manned aviation, not for numerous low-altitude, remotely piloted aircraft. The absence of a dedicated unmanned traffic management system

makes monitoring and enforcement difficult. While CAAB has imposed altitude restrictions and no-fly zones, practical enforcement remains limited due to technological and institutional constraints.

National Security and Public Order

From a national security perspective, drones pose unique challenges. Their ability to carry cameras, sensors, or payloads makes them vulnerable to misuse for surveillance, smuggling, or other unlawful activities. In a densely populated country like Bangladesh, uncontrolled drone operations may also threaten public order and safety.

Although existing criminal and security laws may apply to unlawful drone use, aviation-specific enforcement mechanisms are still evolving. Coordination among CAAB, law enforcement agencies, and security forces is improving, but gaps remain in detection, identification, and accountability.

Privacy and Data Protection Challenges

Drones equipped with high-resolution cameras raise significant privacy concerns.



Bangladesh does not yet have comprehensive and fully implemented data protection legislation that directly addresses aerial data collection. As a result, individuals may be filmed or monitored without their knowledge or consent, creating legal ambiguity regarding privacy rights.

Traditional privacy laws were not designed to address surveillance from the air. The Constitution of the People's Republic of Bangladesh guarantees the right to privacy in correspondence and communication under Article 43, offering a foundational but limited safeguard. In addition, the Penal Code, 1860, contains provisions relating to criminal trespass, insult to modesty, and unlawful intrusion, which may indirectly apply to certain invasive acts. The Information and Communication Technology Act, 2006, and the Digital Security Act, 2018, also address unauthorised access, data misuse, and digital surveillance, but these laws were primarily designed for cyberspace rather than physical aerial monitoring.

These traditional legal instruments were not crafted to regulate modern forms of surveillance from the air. They lack clear standards on consent, lawful purpose, data retention, and accountability specific to drone operations. In the absence of explicit rules governing how data collected by drones may be stored, processed, or shared, the risk of privacy violations continues to increase alongside technological advancement.

Liability and Accountability Gaps

Another major concern in Bangladesh's drone regulation is liability. In the event of accidents, property damage, or personal injury, determining responsibility is legally complex. Questions arise as to whether liability rests with the operator, owner, manufacturer, or software provider.

Currently, there is no mandatory insurance framework specifically tailored to drone operations. This leaves victims uncertain about compensation and discourages responsible commercial use. Clear liability rules and insurance requirements are essential to building trust and accountability in unmanned aviation.

Need for a Comprehensive Legal Framework

Bangladesh's existing approach to drone regulation primarily relies on administrative permissions and circulars issued by the Civil Aviation Authority of Bangladesh (CAAB), serving as a necessary interim response to an emerging technology. However, reliance on fragmented guidelines rather than a consolidated statutory framework reveals significant legal limitations. The absence of a dedicated drone law results in uncertainty regarding legal authority, scope of regulation, and enforceability, particularly when violations occur.

A comprehensive legislative framework specifically addressing unmanned aircraft systems is therefore essential. Such a law could clearly define key legal concepts, including categories of drones, operator status, permissible airspace, and degrees of risk. It would also establish transparent licensing and registration requirements, mandatory training standards, and insurance obligations, ensuring accountability across both recreational and commercial operations. Importantly, a statutory framework would provide a clear basis for penalties and enforcement mechanisms, reducing reliance on discretionary administrative control.

From a legal perspective, a dedicated drone law would also help harmonise aviation safety regulations with constitutional rights, criminal laws, and emerging data protection norms. By clearly allocating responsibilities among regulators, operators, and enforcement agencies, the law could reduce jurisdictional overlap and enhance institutional coordination.

Aligning national drone regulations with guidance issued by the International Civil Aviation Organization (ICAO) would further support the safe and systematic integration of unmanned aircraft into Bangladesh's airspace. ICAO's emphasis on risk-based regulation allows states to differentiate between low-risk recreational use and higher-risk commercial or

sensitive operations, ensuring proportional legal control without stifling innovation.

Conclusion

The rapid growth of unmanned aerial vehicles in Bangladesh brings with it both new opportunities and difficult regulatory problems. Drones are being used more and more for business innovation, research, disaster management, and public service. However, the lack of a clear and comprehensive legal framework has led to regulatory gaps that could put safety, privacy, and national airspace security at risk. Existing rules, though necessary as interim measures, remain fragmented and reactive rather than forward-looking.

A dedicated drone law—clearly defining operational categories, licensing standards, liability regimes, enforcement mechanisms, and penalties—is no longer a policy option but a regulatory necessity. Aligning national regulations with international best practices, particularly the guidance of the International Civil Aviation Organization (ICAO), would enable safer integration of drones into Bangladesh's airspace while supporting innovation and economic growth. Equally important is the establishment of effective interagency coordination among aviation, defence, law enforcement, and data protection authorities to address cross-cutting concerns such as surveillance misuse, airspace infringements, and cybersecurity risks.

As Bangladesh moves toward its vision of a digital and technologically advanced nation, drone governance must evolve in parallel. A balanced legal approach—one that safeguards national security and public interest while encouraging responsible innovation—can transform drones from a perceived regulatory risk into a strategic national asset.

Good regulation shouldn't try to stop new ideas; it should help them grow in a responsible way. By strengthening drone-specific laws, enforcement capacity, and public awareness, Bangladesh can ensure that its skies remain safe, secure, and well regulated in the age of unmanned flight. 🇬🇧



LOW-COST AIRLINES AND MARKET EFFICIENCY: THE BANGLADESH PERSPECTIVE

Shahana Afrin Dina
Assistant Professor (Economics), AAUB

Nowadays, air travel has become very popular among people from almost all classes of society. If we look at global air travel trends over the last decade, industry reports from organisations such as the International Air Transport Association (IATA) and the International Civil Aviation Organization (ICAO) show a sharp rise in passenger numbers, with global air travel increasing by around 40–45 per cent compared to the early 2010s, despite the temporary slowdown during the COVID-19 period. One of the main reasons for this rise is the rapid growth of low-cost airlines, which make air travel more affordable for everyone, especially in developing countries. These airlines not only help more people travel by air but also increase competition among airlines and improve the overall efficiency of the market. Moreover, they contribute to the development of the economy, making it more connected, encouraging tourism and trade, and offering more work, education, and leisure opportunities. In short, low-cost airlines have changed the way people fly and have made the benefits of air travel available to a wider range of passengers, not just the wealthy.

How Low-Cost Airlines Work

Low-cost airlines follow some simple but innovative ideas to make air travel popular and affordable for a large number of people. Their main strategy is to offer lower ticket prices, which they achieve by keeping service costs low. To do this, the airlines provide only basic facilities and limited in-flight services so that people from all income groups can afford to travel. For example, Southwest Airlines, which started its low-cost operations in 1971 in the United States, Ryanair, which adopted the low-cost model in 1991 in Europe, AirAsia, which transformed into a low-cost carrier in 2001, and IndiGo, founded in 2006 in India, all follow this cost-saving approach. These airlines usually operate a single type of aircraft, fly direct routes, keep aircraft in the air for longer hours, and charge separately for services such as meals or baggage. Traditional airlines, e.g., British Airways (established in 1974), Lufthansa (1953) and Singapore Airlines (1972), on the other hand, are aimed at the high-end and business customer and concentrate on the delivery of full services, increased in-flight comfort, and a well-planned network of routes. Because of these differences, low-cost airlines are able to attract a larger number of passengers and now carry a significant share of global travellers, showing how air travel habits have changed over time. From an economic perspective, low-cost airlines increase market competition. Lower prices encourage more people to travel by air, while competition forces airlines to become more efficient. Consequently, a broader demographic, not just high-income individuals, can access air travel and its advantages.

Benefits for Passengers and the Economy

The most noticeable impact of low-cost airlines is lower airfares. In most developing economies, flying used to be an exclusive

experience of the business traveller and better-off people in the society, as airlines charged high fares, but with the introduction of low-cost airlines, air travel has become affordable to students, middle-income families and small entrepreneurs. It enhances consumer welfare since individuals are able to spend less on travel and have more time for work, education, and leisure. The low-cost airlines also contribute to competition that compels ordinary airlines to revise prices and services and work more productively, and this effort in the long term provides a balance and competitive aviation market. In addition to reduced fares, improved air connectivity promotes tourism, trade, worker mobility, and regional development. Studies by organisations like ICAO and the World Bank indicate that efficient aviation markets are part of economic growth and enhanced global integration.

Risks and Challenges of Low-Cost Airlines

Basically, low-cost carriers offer several advantages for developing countries, but they also create some difficulties. As lower fares encourage more people to travel, passenger numbers increase rapidly, which puts extra pressure on already crowded airports. The expected efficiency benefits of low-cost airlines diminish when terminal, runway, and airport facility investments do not keep pace. Other concerns are safety, environmental effects, and market consistency. There should be strong regulations to uphold the safety standards as the market expands and carbon emissions are increasing due to the rise in air traffic, unless backed by more sustainable technologies and climate policies. Moreover, not every low-cost airline is successful, and airline exits are able to provoke a temporary interruption of air service. Such problems demonstrate that it is possible to make low-cost airlines effective at enhancing market efficiency when they have proper infrastructure, effective regulation, and long-term planning. This fact can be demonstrated by the aviation industry of Bangladesh; despite the rapid market expansion, the development of the low-cost airline model has not been achieved due to structural constraints.

Aviation Market in Bangladesh: Growth, Competition and Structural Characteristics

The aviation sector in Bangladesh has grown rapidly in the past ten years due to increasing incomes, high overseas labour migration, increasing tourism demand and increased integration into the global economy. In 2023,

“Enhanced surface transport infrastructure (Padma Bridge) has brought about new competition in selected routes, which can be seen as an example of road and air transport in determining market efficiency.”

Bangladesh was the 51st largest aviation market on the global list based on passenger departures, and the international traffic constitutes almost 70 per cent of the total origin-destination traffic. Passenger data reflects this positive trend. Airlines have transported around 6.63 million passengers in 2023, compared to 5.27 million in 2022, showing both a recovery in the air transportation sector in the post-pandemic period and growth in the long-term demand for the air travel industry. Other than the volume of passengers, aviation plays a significant role in the economy. The aviation industry, as per the International Air Transport Association (IATA), is estimated to add approximately USD 5.3 billion to Bangladesh's GDP and employ approximately 475,000 individuals in the airline sector, airports, tourism, and related sectors.

Domestic Airlines and Market Trends

Bangladesh has yet to build a strong and loyal low-cost airline like the competing South and Southeast Asian markets, where prevalent low-cost carriers like IndiGo, AirAsia, and Lion Air have become established. Rather, a hybrid type of market structure has been developed. There are local carriers who run domestic routes and limited international routes with regional flights, such as Biman Bangladesh Airlines, US-Bangla Airlines, Novoair, and Air Astra. Meanwhile, approximately three-quarters of all international traffic is intercepted by foreign airlines, and the domestic carriers are granted a relatively lesser portion of the cross-border services. Such an imbalance has yielded mixed results. Constructive international competition has enhanced international connectivity and levelled fares on certain routes. Nevertheless, it has reduced the capability of local airlines to scale, invest in cost-effective fleets, and embrace low-cost business models in full. In the national marketplace, Bangladeshi airlines mainly act as full-service or semi-low-cost carriers. Although they implement certain efficiency techniques, they are not as large as common low-cost carriers. In one example, high seat occupancy rates were registered by US-Bangla Airlines in 2023, which is an indication of strong domestic demand, and Novoair is building strong connectivity within the secondary cities. Travel within the country has proven to be stable since the COVID-19 recession, especially business- and labour-related travel. Meanwhile, enhanced surface transport infrastructure (Padma Bridge) has brought about new competition in selected routes, which can be seen as an example of road and air transport in determining market efficiency.

Foreign Airlines and Market Effects

Foreign airlines are dominant in Bangladesh, which has both opportunities and inefficiencies. International carriers increase route options and enhance connectivity in the world, but overreliance on foreign carriers may push local carriers off lucrative routes



Low-cost models have been effectively applied in India by low-cost carriers like IndiGo, which have gained large market shares in the domestic market and are able to extend their services to international markets with the help of liberalised policies and low airport charges

and reduce the growth of domestic networks. Revenue outflows are one of the areas of concern. IATA has identified Bangladesh as a country facing challenges in repatriating airline revenue, resulting in significant retention of funds. Such restrictions increase the cost of operation and decrease reinvestment motivation. In the meantime, passenger volumes at Hazrat Shahjalal International Airport have approximately doubled since 2014, but the market share of local airlines has not been growing accordingly because of fleet limitations, policy barriers, and capacity limitations.

Opportunities, Obstacles, and Policy Needs in Bangladesh's Aviation Sector

The aviation market in Bangladesh demonstrates definite efficiency improvements. The availability of air travel has increased, regional and international connectivity has been enhanced, and economic spillovers associated with aviation, like employment, tourism, and GDP, have increased. The actual airfare has also dropped over time, following a broad global trend influenced by competition and operational efficiency. Nevertheless, this advancement is still hampered by structural limitations. Regulatory frameworks have not

been liberalised as fast as they have in other similar developing markets. Airport fees and ground-handling expenses are high in comparison with those of the region, and multifaceted repatriation of revenues adds to the expenses of the domestic and international airlines. Moreover, Bangladesh has a weak position as a transit hub, with the majority of international passengers being point-to-point travellers, which diminishes the network efficiency and growth prospects of hubs. Compared to India and other Southeast Asian regions, Bangladesh's aviation industry remains more limited. Low-cost models have been effectively applied in India by low-cost carriers like IndiGo, which have gained large market shares in the domestic market and are able to extend their services to international markets with the help of liberalised policies and low airport charges. Low-cost airlines in Southeast Asia have also contributed to the movement of people and tourism in the region. Specific reforms will need to enhance market efficiencies in Bangladesh. The main priorities are the modernisation of the regulations, competition in airport pricing, balanced bilateral air service contracts, and increased access to aircraft financing for local airlines. All these measures would

have the potential to help build a more efficient and balanced aviation market, which has high international connectivity and sustainable domestic airline development.

In most developing nations, air travel has become more affordable and accessible due to the low-cost airlines. They enhance competition and therefore efficiency in the market and also open travel opportunities beyond high-income groups. Such advantages, however, require good infrastructure, regulations, and planning. The aviation market in Bangladesh has been expanding rapidly, but there is not much influence of low-cost models. Although foreign airlines have enhanced the connectivity in the international frontiers, domestic airlines are experiencing a challenge associated with exorbitant costs, regulatory obstacles, and small size. Consequently, there have been unequal efficiency gains. Bangladesh can utilise low-cost aviation better with improved policies, reduced airport expenses, and the beneficial positioning of local airlines to enhance connectivity and economic growth within Bangladesh. The major difficulty lies in creating an environment that allows for the maintenance of efficiency gains and supports the overall economy. 🌍

References

- Airports Council International. (2022). World Airport Traffic Report 2022. Airports Council International.
- Bangladesh Civil Aviation Authority. (2023). Annual report 2022–2023. Civil Aviation Authority of Bangladesh.
- Button, K. (2010). Transport economics (3rd ed.). Edward Elgar Publishing.
- Dobruszkes, F. (2006). An analysis of European low-cost airlines and their networks. *Journal of Transport Geography*, 14(4), 249–264. <https://doi.org/10.1016/j.jtrangeo.2005.08.005>
- Francis, G., Humphreys, I., Ison, S., & Aicken, M. (2006). Where next for low-cost airlines? A spatial and temporal comparative study. *Journal of Transport Geography*, 14(2), 83–94. <https://doi.org/10.1016/j.jtrangeo.2005.05.005>
- International Air Transport Association. (2023). Economic performance of the airline industry. IATA.
- International Civil Aviation Organization. (2022). ICAO annual report 2022. ICAO.
- O'Connell, J. F., & Williams, G. (2005). Passengers' perceptions of low-cost airlines and full-service carriers. *Journal of Air Transport Management*, 11(4), 259–272. <https://doi.org/10.1016/j.jairtraman.2005.01.003>
- Pearce, B. (2019). Low-cost carriers and their impact on airline competition. International Air Transport Association.
- Pels, E. (2008). Airline network competition: Full-service airlines, low-cost airlines and long-haul markets. *Research in Transportation Economics*, 24(1), 68–74. <https://doi.org/10.1016/j.retrec.2009.01.010>
- World Bank. (2021). Air transport and economic development in developing countries. World Bank Group.
- World Bank. (2023). Bangladesh development update: Leveraging connectivity for growth. World Bank Group.



THE JOURNEY OF HOPE FROM BANGLADESHI SKIES TO GLOBAL STAGE: TEAM ABABIL'S CANSAT ODYSSEY

Muhtasim Redwan (ID: 22024002)

Student, Department of Avionics Engineering, AAUB

Inside the vibrant labs of the Aviation and Aerospace University, Bangladesh (AAUB), a group of passionate students was working on a project they believed could transform the nation's space aspirations. They were focused on constructing small satellites, which are tiny cubes that could potentially unlock new opportunities in space.

The project, Pico Satellite for Bangladesh, was initiated through a partnership between the Aviation and Aerospace University, Bangladesh, and the Pico Satellite Company of Bangladesh. Two dedicated labs were established—one at the Dhaka campus and the other in Lalmonirhat. Professor Dr Nazmul Ula, founder of the Pico Satellite Company and a faculty member at Loyola Marymount University in the U.S., serves as the

project's Principal Investigator (PI). Air Commodore (Retd.) Dr Md Afzal Hossain serves as the Co-PI, and Assistant Professor Md Samin Rahman serves as the overall coordinator. Furthermore, the ICT Division of Bangladesh supported the project as well. By the end of 2023, the team aimed to complete a fully functional 1U CubeSat. Riding on that momentum, the exciting phase of CanSat 2025 began.

The CanSat competition challenged students to design, build, and launch a can-sized satellite that, once released mid-air from a rocket, would perform various tasks during its descent—collecting data, deploying a parachute, and simulating a real satellite mission.

What is a CanSat?

A CanSat is a small satellite model designed to fit inside a regular soda can. It isn't an actual satellite that travels to space; instead, it serves as a simplified version aimed mainly at educational purposes. Students and young engineers use it to learn how real satellites work in a smaller, more affordable, and hands-on way. The CanSat is launched by a rocket at a height of around 500 to 1,000 meters. Once it reaches this height, it is released and starts to fall back to the ground. During this descent, the CanSat performs various tasks just like a real satellite would.

The **CanSat** was inspected, and technical details were **verified**. Only two teams received a perfect score that day—**Team Ababil, AAUB** and a team from **Argentina**.

Most CanSats are designed to open a parachute after being released, allowing them to fall slowly and safely. While descending, CanSat collects and sends important data, such as temperature, air pressure, altitude, and sometimes GPS location. It may also include cameras or other sensors, depending on the mission. The data is sent in realtime to a ground station or stored for later analysis.

This idea caught the attention of the PicoSat core team. Air Cdre (Retd) Md Afzal Hossain, BUP, ndc, psc, Ph.D., Distinguished Professor, gave his approval, and the groundwork initially began with Assistant Professor Dr Sakir Hossain. Later, Assistant Professor Md Samin Rahman stepped in as the official team advisor. Eight students were selected and registered just before the deadline. But there was a catch—final exams were only days away. The real work would have to wait.

Once the exams ended, the clock started ticking fast.

The first phase was the preliminary design review, which required a full breakdown of the mission: structure, electronics, payload, descent mechanism, power systems—everything. The students split into small groups and began writing, designing, and reviewing. They submitted the documentation just in time.

The result? They scored 98.2%—marking a spot among the highest-ranked teams globally.

Next stage: Critical Design Review. In this phase, the team was required to build a real, working prototype. They had to present hardware, software, and fully functional systems. Recognising the potential of the team, the vice-chancellor stepped forward with institutional funding and full administrative backing. His leadership and belief in the students' mission were instrumental in powering this dream.

The mechanical team spent hours rechecking dimensions. They printed parts overnight—often waking up to find that the prints had failed mid-process. Undeterred, they cleaned, recalibrated, and tried again. Meanwhile, the electronics team built their circuits on breadboards, tested each line of

code, and progressed toward the final PCB designs. Once ready, the boards were sent to China for fabrication, with the university authorities assisting with costs and import procedures.

The satellite was slowly taking its shape. But the challenges were far from over. As the competition's environmental testing phase approached, the team realised they couldn't carry the load alone. A call for new members was announced, and thirty junior-level students joined. Ababil was no longer just a project—it had become a mission.

Testing had to be real. The satellite needed to survive air pressure, temperature changes, vibrations, and shock. That's when unexpected support arrived. The university leadership, including the Pro Vice Chancellor, Treasurer, Registrar, Dean (FAET), and HoD (Avionics Engg), played critical roles in enabling logistics, lab resources, and academic flexibility to allow the team to prepare. In the lab, thermal testing, vibration analysis, and vacuum simulations pushed the satellite closer to flight readiness. The descent team tested parachute performance in AAUB's subsonic wind tunnel, checking for stability and drag under various conditions.

In the final stage, the decision was made to build three complete prototypes. Each one would serve as a backup or for testing and training. Regular university classes had resumed. But the team kept going. Days were spent in classes, nights were spent in the lab. Some students didn't go home for days. They carried notebooks in one hand and soldering irons in the other. The three CanSats were completed. At the time, Air Commodore FORHAD HOSSAIN MAHMUD, BSP, BPP, AFWC, PSC, PMP, Dean of the Faculty of Aviation Engineering Technology, and Group Captain Toyobur Rahman, AFWC, PSC, Ph.D., Chairman of the Avionics Department, took on the responsibility of managing the overall plan and logistical arrangements that made the team's journey to the USA possible.

With support and direction in hand, TEAM ABABIL boarded their flight to the USA. The itinerary included transits through Dubai and Milan, ending with a landing at John F. Kennedy International Airport in New York

City. From New York, the team continued its journey to Virginia by road. The drive was long but smooth. After reaching their destination, they checked into the hotel and started preparing for the big event. The prototypes were unpacked, tools laid out, and final assembly started.

The following day, the team attended the pre-flight briefing. It was their first chance to meet the other teams. Students from around the world had gathered, each with their own designs, hopes, and stories. This was more than just a competition—it was a global gathering of young minds. The Flight Readiness Review followed. The CanSat was inspected, and technical details were verified. Only two teams received a perfect score that day—Team Ababil and a team from Argentina, who would later become the champions. It was a proud moment.

Launch day arrived.

The team travelled by bus to Monterey, where the rocket launches were scheduled. The road wound through hills and open skies. Clouds touched the ridgelines. It felt like driving through a postcard. At the launch site, the team carried out final checks. Sensors were calibrated, batteries tested, and the CanSat was loaded onto the rocket. All systems were ready. The rocket soared into the sky. At first, everything went smoothly. The release sequence was expected, but then something didn't go as planned. The microcontroller malfunctioned, causing a delay in the release mechanism. Because of that delay, the CanSat failed to deploy on time. Still, the rest of the systems worked well. The descent team recovered the CanSat. The damage was minimal, and all collected data was retrieved. The team had done everything they could. The next morning, the team presented their post-flight review to the judges. Every detail was explained—what had gone right, what had gone wrong, and what had been learned. The judges appreciated the honesty and technical clarity. One day later, the final rankings were announced. The AAUB team secured 16th place worldwide. Among dozens of international teams, it was a strong showing, especially for a first-time entry from a young university. 🌍

WHERE WINGS MEET INCLUSION: ENGINEERING BELONGING IN AVIATION AND AEROSPACE

Wg Cdr Tajmahir Islam Teethi, psc, Programme Coordinator, SCNT, AAUB
Mahmuda Akter, Lecturer, AAUB

*a*viation engineering is one of humanity's most ambitious projects: the desire to defy gravity, fly across the ocean, and reach distant worlds. Since the first flight experiments and the research of planets, these fields have required accuracy, boldness, and continuous innovation. Over two hundred years, women have been able to contribute to this advancement in the background, often invisibly and often against resistance but always decisively. Even before aviation became an industry and spaceflight a symbol of geopolitics, women played a significant role in developing its intellectual foundation.

During the early 20th century, women like Elsie MacGill, the first female aeronautical engineer in history, had been involved in the design of the Hawker Hurricane fighter plane in World War II and thus was nicknamed the "Queen of the Hurricanes". Besides the design and production, her innovation of ski-equipped landing gear and de-icing equipment made Hurricane suitable for cold weather operation. Amelia Earhart, in addition to her popularity as a pilot, was a trained engineer whose contributions to the understanding of aircraft design were in the form of a practical flight experiment. Subsequently, Katherine Johnson, Dorothy Vaughan, and Mary Jackson revolutionised aerospace engineering at NASA by computing orbital mechanics, which paved the way for the first human spaceflights and moon trips. Their activity did not only reinforce aviation and space programmes; rather, they would have been impossible without their contribution. With the passage of time the aviation and

aerospace sectors grew, processing the heavily male-dominated workplace cultures. Engineering excellence has got intertwined with the past social norms in which there are long hours, post-work networking, informal technical gatekeeping, and the expectation of constant availability. Even now in most societies, and mainly those with strong traditional norms, women in aviation and aerospace are still regarded as not compatible in the high-risk and high-responsibility environment like flight systems design, propulsion engineering or mission control leadership. Commitment is rarely assessed based on safety records, system reliability, or design innovation but on being in social rituals that are beyond the financial means of many of the women.

Practically, women from the aviation and aerospace sectors do different types of dual navigation. When examining wind tunnels, simulating flight, or even satellites, most of them are also working on the unseen tasks of their households

and families. With caregiving being female-dominated, this parallel workload is not an aspect of weakness but a display of remarkable operational discipline. The process of creating a safe aircraft or a dependable spacecraft, along with managing these layered responsibilities, does not lead to divided attention but rather fosters an outstanding level of thinking.

The tenacity to make it through these conditions is actually encoded in the history of aerospace innovation itself. 'Software engineering' was coined in 1969 by Margaret Hamilton, head of the software team of the NASA Apollo missions, as she wrote fault-tolerant program code that rescued Apollo 11 on its descent to the moon. The aerospace engineer and astronaut Kalpana Chawla is an example of a person with a humble origin that made it into space and proved that anyone in the world can be part of the global space science community. As an engineer, astronaut and then the director of the Johnson Space Center of NASA,

Ellen Ochoa revolutionised the satellite imaging technologies and shattered leadership boundaries in the space administration. These women did not achieve success because the system accepted them; rather, their success was due to the fact that their skills were indispensable.

At the turn of the 20th century, women in the world made up less than 1 percent of engineers, including in the engineering field of the aviation industry. They often concealed their contributions by listing them under titles like assistant, calculator, or draftsman. After World War II, women were aircraft planners, fleet managers, and logistics optimisers. The postwar industry ejected many of them systematically out of the aviation industry and reduced it to approximately 3% participation by 1950. This devastation has impeded innovation and deprived aerospace systems of essential points of view.

Long-term data reveals this fact. Figure 1(a) indicates the steady rise in the number of women in aviation and aerospace engineering between the years 1980 and 2025. In 1980, women constituted only 4 percent of the field. In 1990, the number had increased to 6% and, according to the year 2000, to 9%. The next decades continued this improvement, with 12% in 2010, 16% in 2020, and approximately 18% in 2025. The trend is on the increase, but so is the rate. In less than 45 years, the workforce has been less than a fifth of its former size. These statistics are tales of perseverance and defiance.

On a closer examination, the participation differs widely in terms of speciality. Figure 1(b) illustrates the representation of women in various aviation and aerospace fields. Other fields with relatively greater participation, say air traffic engineering, where systems thinking, coordination and safety protocols are the dominant daily work activities, are around 20%. Aerospace engineering and space systems engineering are next in line, with avionics engineering coming a bit lower. However, the most skewed is aircraft maintenance



engineering, in which women constitute about 12% of the labour force. These are not coincidental differences. These echo the influence of the workplace culture, physical demands and career flexibility on those who remain and those who do not.

The image is even clearer when considering the data presented in Figure 2, which compares the participation of women in the United States, the European Union, and Asia-Pacific. Women predominantly occupy job positions related to air traffic across all regions, while aircraft maintenance rates remain relatively low. Europe is slightly ahead in the aerospace and avionics occupations and enjoys the advantage of decades-old

policy frameworks to entrench gender equity in research funds and institutional governance. The same patterns are observed in the United States and Asia-Pacific areas, indicating that culture is very important but that policy design is a determining factor in the development of opportunity.

Over the years, there has been no better gift to the profession than the social grouping that organisations like Women in Aviation International (WAI) and the Society



Figure 1: Historical Trend of Women's Representation in the Global Engineering Workforce (1980-2026)

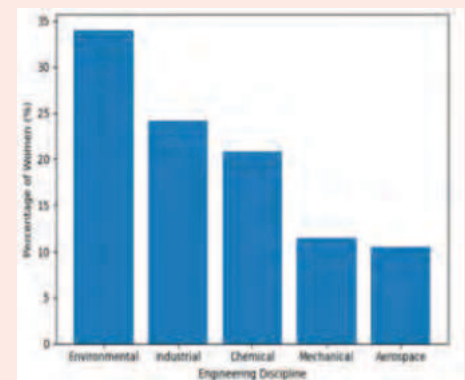


Figure 2: Distribution of Women Across Engineering Disciplines by Field in 2026

of Women Engineers (SWE) have been able to offer. Being visible, receiving mentorship, and sharing knowledge have enabled many women to remain in the field, where they would have otherwise been isolated and cast out. These networks do not just promote, but they open avenues where none have been there before.

Technology alone cannot secure the future of aviation and space exploration. It will depend on whether the field can fully engage every capable mind it trains. When women are allowed to contribute without carrying disproportionate burdens and where expertise is trusted and effort is measured fairly to make the entire system perform better. Recent surveys on equity in the workplace for engineers highlight that gender-based obstacles often manifest as a form of professional "violence" which is not always physical but deeply damaging. Such violence includes the dismissal of technical input, being overlooked for leadership roles, or the subtle exclusion from informal decision-making circles.

The first step in the recovery process is to

convince institutions to accept that gender-based inequity is a systemic failure rather than a personal problem. Mentorship initiatives, work-life policies, and reporting safety are necessary, though impossible without male allyship. Our society can be changed in the best way through the supportive partnership of male colleagues. Equity is real when male co-workers challenge ingrained prejudices, when those male partners are involved in household chores, and when the heads of organisations appreciate performance over physical appearances. Also, the best buildings are those with all parts in harmony.

Ultimately, the future of aviation engineering depends on cooperation, not rivalry between genders. A society that expects women to carry both the blueprint and the burden cannot innovate sustainably. When men and women work as allies, respecting boundaries, valuing empathy, and recognising invisible labour, engineering becomes not just a profession but a shared human endeavour. Together, let's engineer a future where every talent has the time, respect, and space to shine and spread their wings in the sky. 🌟

Key References

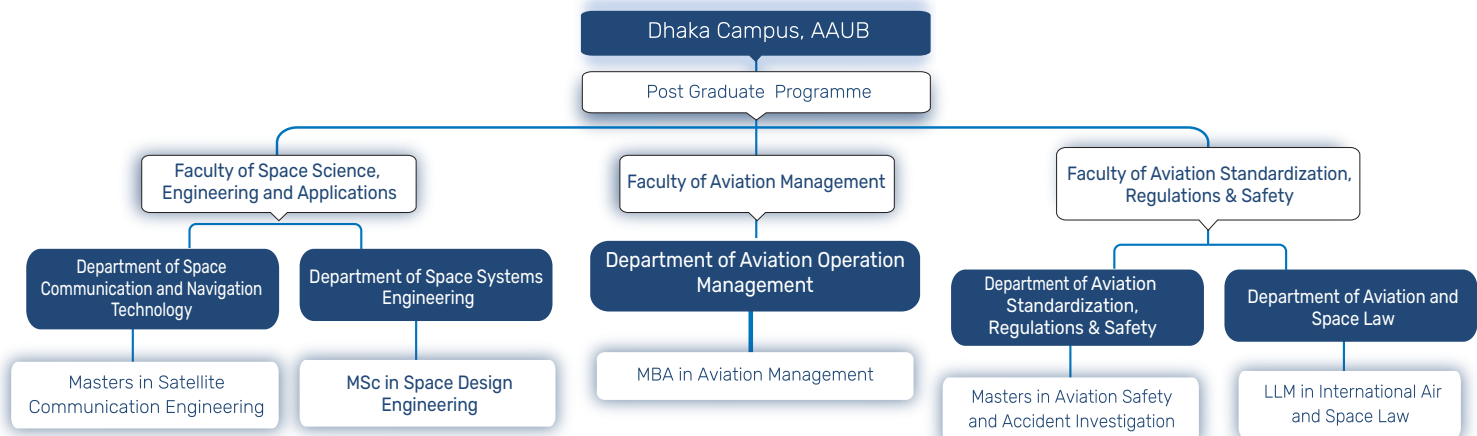
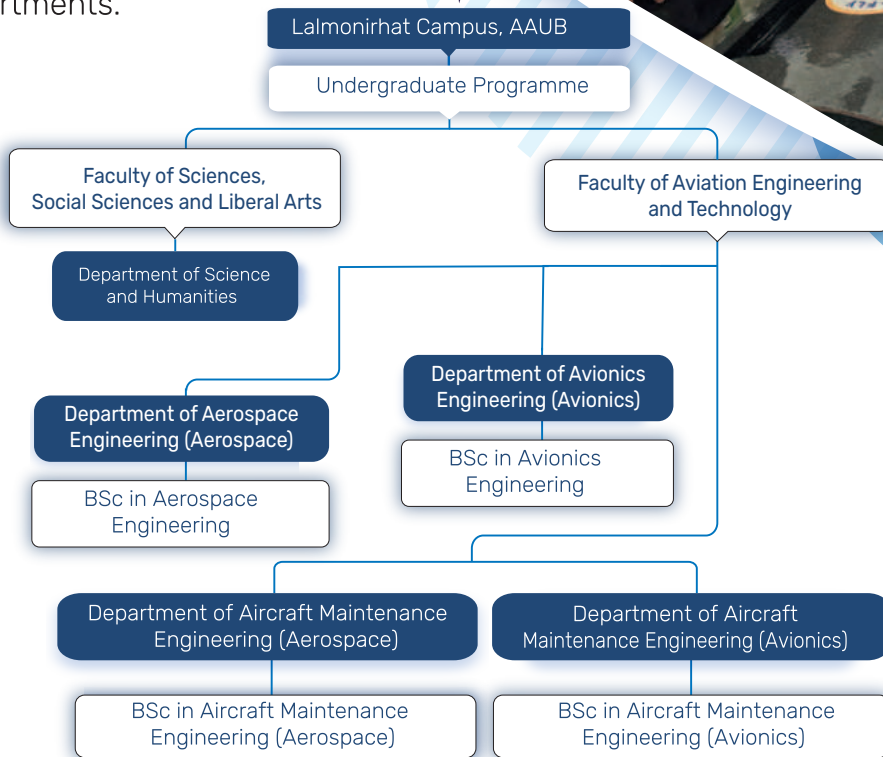
- NASA Office of Diversity and Equal Opportunity. (2021). Diversity and inclusion: a strategic implementation plan.
- Women in Aviation International (WAI). (2023). Women in aviation workforce statistics.
- Society of Women Engineers (SWE). (2024). Engineering by the numbers.
- UNESCO. (2022). Gender equality in STEM: Global trends.
- European Commission. (2023). Horizon Europe is a gender equality strategy.
- European Union Aviation Safety Agency (EASA). (2023). Human factors and workforce diversity in aviation safety.





FACULTIES AND DEPARTMENTS

AAUB is committed to academic excellence, innovation, and hands-on learning through our diverse faculties and specialised departments.



An **AAUB** Publication



Old Airport, Tejgaon
Dhaka 1215
www.aaub.edu.bd

