



FRAGILE FRONTIERS

Where Innovation, Politics, and Power Collide in Space



Engineered by
Dr. Srimathy Kesan

Fragile Frontiers

Where Innovation, Politics, and Power Collide in Space

First Edition

Author

Dr. Srimathy Kesan



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Contact: +91- 8861511583
E-mail: sales@iipbooks.com

Fragile Frontiers

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Humanity's fascination with the stars is as old as our ability to wonder. From the first flickering campfire stories to the powerful telescopes of the modern era, space has been both a canvas for imagination and a frontier for discovery. Yet the journey beyond our planet is no longer merely a tale of rockets and satellites. It is a story woven with ambition, rivalry, collaboration, and the complex politics that govern who can reach the heavens and how.

Every mission, every satellite, every human stepping into orbit carries with it the weight of competing priorities. Innovation does not occur in isolation; it is shaped and constrained by bureaucracy, finance, national interests, and global expectations. The International Space Station symbolizes what can be achieved when nations cooperate, while the scramble for lunar and Martian territory reminds us how fragile peace and trust can be beyond Earth.

This book explores the delicate balance between opportunity and risk, progress and peril. It examines how cutting-edge technology collides with political agendas, how power struggles influence exploration, and how the ethical challenges of space ownership, environmental impact, and inclusion demand thoughtful solutions. In these fragile frontiers, every decision resonates far beyond the spacecraft and control rooms; they echo across generations, shaping humanity's future in ways we are only beginning to understand.

As you turn these pages, you will encounter the triumphs, the failures, and the conflicts that define modern space exploration. You will see how innovation can be stifled by delay, how collaboration can overcome rivalry, and how fragile decisions today will determine whether the cosmos becomes a shared resource or another stage for division. Above all, this is a story about astronauts, scientists, engineers, policymakers, and dreamers and the choices we make as we step into the unknown.

Space is a frontier unlike any other - fragile, unforgiving, and yet brimming with possibility. The journey that lies ahead is not just about reaching the stars; it is about redefining himself

Preface

"Creating a New Young India – Making Space Explorable and Economical for the Future Generation." – Dr. Srimathy Kesan Space is not just a frontier—it is courage in action, vision in motion, and dreams made real. Every failure, every challenge, every sleepless night is a step toward the impossible. From carrying payloads on bicycles to launching **KalamSAT**, **AzaadiSAT**, and the upcoming **Mission ShakthiSAT**, India's journey into space is a story of resilience, innovation, and unbreakable spirit.

This book celebrates the dreamers, the students launching balloon satellites, the engineers working through the night, and the pioneers who refuse to give up. The frontier may be fragile, but our courage, creativity, and determination are limitless.

Dream boldly. Fail bravely. Rise relentlessly. The stars await those who dare.

– **Dr. Srimathy Kesan**

Founder & CEO, Space Kidz India

Mission Director, Mission ShakthiSAT

Foreword

Wg. Cmdr. Rakesh Sharma (Retd)

I have had the privilege of knowing **Dr. Srimathy Kesan** for about a decade now. On our first meeting, I was struck by the passion with which she was leading a small bunch of excitable kids and inducting them into the wonders of space sciences. Even more laudable was the fact that she was deploying her personal financial assets to fuel this excitement amongst the small bunch of children on the subject of space exploration.

She did not stop at building only academic interest in them but actually encouraged them to translate academic knowledge into building hardware for space applications, decidedly a better way of learning; a better way of staying motivated to learn more about this vast subject.

Over the years she has mentored many students and, in return, they have made her proud by actually putting together hardware that has been launched into space successfully and met all of its design objectives.

Going forward, we are destined to see many changes being made to the way space exploration has been managed thus far. Today, we are at an interesting crossroad. Space exploration never came cheap. Now that humanity is preparing to colonise rather than merely visit destinations in our solar system, we can be sure that the capital investment required for this activity will be beyond the resource capability of any one nation. Perforce, nations will need to collaborate by supplying both human and financial resources to make colonisation happen. No more will this activity be the

preserve of any one nation but a combination of skill sets available across the globe.

The United Nations' outer space treaty of 1967 clearly states that space belongs to all of humanity. It follows that what we farm out there ought to benefit all of humanity. This is where an inclusive rather than an exclusive approach recommends itself – a model that is being followed assiduously by India. We have been freely sharing all scientific data gathered by our space probes with other space faring nations while at the same time, using our space based assets to warn all nations of impending climate disasters.

By firing the imagination of our youngsters to pursue a career in India's rapidly expanding space industry, Dr Kesan is providing much needed impetus to it. I am confident that some of our future space professionals will be drawn from her 'space nursery' named Space Kidz India!

I commend her contributions and wish her all the very best for her future endeavors in this domain.

About our Hero



Rakesh Sharma is a former **Indian Air Force Wing Commander** and the **first Indian citizen to travel in space**. He flew aboard the Soviet spacecraft *Soyuz T-11* in 1984 as part of a joint mission between **ISRO and the Soviet Interkosmos program**. During his time in space, he conducted scientific and technical studies. When asked how India looked from space, he famously replied, “*Sare Jahan Se Achha*”. He was awarded the **Ashoka Chakra**, India’s highest peacetime military honor.

Honourable Minister

Savannah Maziya

The cosmos has always been more than a frontier, it is a mirror of our shared humanity, our ambitions, and our vulnerabilities.

In Fragile Frontiers - Where Innovation, Politics, and Power Collide in Space, Dr. Srimathy Kesan captures this truth with the precision of a satellite's orbit and the passion of a pioneer. The stars do not discriminate; they shine on every nation, every dreamer, every young mind daring to look upward. Yet, as Dr. Kesan so eloquently reveals, reaching them requires navigating the fragile intersections of technology, geopolitics, and the human spirit—a delicate balance where missteps can echo across generations.

As the Minister of Information, Communication, and Technology for the Kingdom of Eswatini, I have seen how space exploration can bridge divides. Beyond science, it fosters cultural exchange, economic opportunity, and a collective vision of a more equitable future. Dr. Kesan's narrative resonates with Eswatini's aspirations - to empower our youth, especially our girls to claim their place in the global story of innovation. This book underscores how political manoeuvring and power dynamics can either stifle progress or, when guided with wisdom, unlock opportunities for all.

One such opportunity is embodied in the collaboration between **India and Eswatini** through **SpaceKidz India's Mission ShakthiSAT**. Under Dr. Kesan's visionary

leadership, this female-led lunar satellite mission has united 12,000 girls from 108 countries, including 108 remarkable participants from Eswatini. For these young women—from the lively streets of Mbabane to the resilient rural communities—ShakthiSAT represents more than satellites. It symbolizes belonging, leadership, and possibility. As I have often said, “Girls hold half the sky.” When they rise, nations rise with them. Through India’s generosity, Eswatini’s daughters are not only inspired but also equipped with skills in science, technology, and innovation.

India continues to stand with us in capacity building, ensuring our youth particularly our girls are prepared to lead in the global knowledge economy.

SpaceKidz India has generously opened this door, equipping Eswatini’s daughters with the skills to design, build, and launch payloads into lunar orbit. This is a revolution in STEM education, ensuring that no girl is left behind in the race to the stars. It also resonates with Eswatini’s own pursuit of the stars. The Kingdom is boldly charting its path by developing a National Space Science Strategy, a vision that places Eswatini among the community of nations preparing to explore, innovate, and contribute to humanity’s journey beyond Earth. For us, the Strategy is not only about science; it is about imagination, dignity, and the conviction that even small nations can dream big and help shape the future of space.

This initiative shines as a model of **India-Eswatini partnership** - a bridge built not of steel, but of dreams and determination. In an era where space risks becoming another arena for division, such collaborations remind us of its

potential to unite. *Fragile Frontiers* calls us to this higher vision, urging policymakers, innovators, and dreamers to prioritize inclusion, sustainability, and resilience. Its chapters are more than analysis; they are blueprints for action guiding us to transform fragility into strength.

To Dr. Srimathy Kesan, I extend my deepest admiration for crafting a narrative that transcends borders and ignites imaginations. May *Fragile Frontiers* inspire countless readers to champion equitable access to the stars, just as Mission ShakthiSAT has done for our girls. And may the enduring partnership between India and Eswatini soar ever higher, fostering innovations that echo across the heavens while grounding us in shared prosperity.

Dream boldly, collaborate fearlessly, and reach relentlessly. The cosmos awaits us all.

Our International Friend



Honourable Savannah Maziya, hailing from Siteki in Eswatini's Lubombo region, is a distinguished leader in ICT and STEM education. Currently serving as Minister of ICT and Senator under the leadership of His Majesty King Mswati III, she has also held key roles as CEO of Bunengi Investment Group and The African Broadcast Network. With a career spanning broadcasting, mining, energy, infrastructure, oil and gas, and finance, she continues to champion technological transformation, educational reform, and youth empowerment on a global stage.

Dr. Tessa Thomas

The exploration of space has always been more than a technological pursuit—it is a testament to the courage, resilience, and imagination of humanity. **In *Fragile Frontiers - Where Innovation, Politics, and Power Collide in Space*, Dr. Srimathy Kesan** brings forth a narrative that beautifully captures this truth, highlighting how innovation, politics, and human determination intersect to shape our collective journey among the stars.

The book resonates deeply with me, as it echoes the challenges and triumphs I have witnessed in India's own odyssey of scientific advancement. From the early days of improvisation and resource constraints to the landmark achievements of **Chandrayaan-3, Aditya-L1**, and beyond, we have learnt that progress in space is never the result of technology alone. It is born out of conviction, nurtured by collaboration, and tested by the will to overcome adversity.

What makes this work exceptional is its insistence on inclusion. By bringing the voices of students, especially young girls from across India and the world, into the larger canvas of space exploration, **Dr. Srimathy reminds us that the sky is not reserved for a few, it belongs** to everyone who dares to dream. This spirit of democratizing access to space science will define the future of humanity's presence beyond Earth.

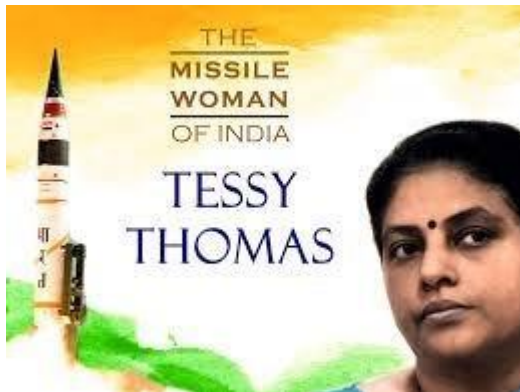
Space is fragile, and so is the trust that binds nations, communities, and individuals together in this pursuit. Yet within that fragility lies promise. If guided by responsibility,

equity, and vision, our exploration of the cosmos can unify rather than divide, inspire rather than exclude.

I commend this book for its clarity, passion, and courage. It will inspire not only scientists and policymakers, but also every young dreamer who looks up at the night sky and wonders what lies beyond. The future of space belongs to such dreamers, and it is our duty as mentors, leaders, and citizens of Earth to ensure that they inherit both the knowledge and the responsibility to explore wisely.

About our Legend

Dr. **Tessy Thomas** is an Indian scientist and aerospace engineer, popularly known



Missile Woman of India. She is the first woman scientist to **head a missile project in India** and played a pivotal role in the development of the Agni series of ballistic missiles under the **Defence Research and Development Organisation**

(DRDO), she overcame early challenges to rise as a trailblazer in the field of defence technology. Dr. Thomas has served as the Director General of Aeronautical Systems, DRDO, and her leadership has been instrumental in strengthening India's strategic capabilities. She is celebrated as a symbol of women's empowerment in science and technology.

Dr. Claire A. Nelson

What makes a person tick?

What stirs the heart so deeply that it will not rest until a dream is born?

What makes a little girl in India lift her eyes to the night sky and decide that the stars are not simply lights to admire but a destiny to claim?

In this book, we find out the answers to such questions for Dr. Srimathy Kesan, who has beaten the odds, the doubters and the naysayers to lead one of the most successful youth space organizations in India – **Space Kidz India**.

You could say it was in the stars. Blueprinted into her DNA. Her very name carries a prophecy. In Tamil, Sri speaks of prosperity, sacred grace, and radiant blessing. Mathy means both the moon and a luminous mind. Together, Sri Mathy becomes “the moon- bright intellect of auspicious grace.” Could there be a truer reason than this for a woman whose life shines with steady brilliance and whose mind is fixed on the stars? This book tells how Dr. Srimathy stepped out, beyond the comfortable rhythms of home to embrace a mission that, at first glance, might seem beyond her reach. But is it really beyond anyone’s reach to dream? There is a saying - First you dream, then you dream.

Dreaming is a human right. Dr. Srimathy’s story shows that daring to A dream and daring to act are what transform impossibility into destiny. Her story parallels the story of India’s space journey. India is living through a remarkable

moment. In barely six decades the **Indian Space Research Organization (ISRO)** has leapt from the modest Aryabhata satellite of 1975 to a procession of triumphs - Chandrayaan-1 in 2008, discovering water on the Moon; the audacious Mars Orbiter Mission in 2014, first Asian craft to circle the Red Planet; Chandrayaan-2 in 2019, mastering complex lunar-orbiter technology; and Chandrayaan-3 in 2023, the historic soft-landing near the Moon's south pole. These milestones proclaim that the race for the Moon and the stars is no longer the preserve of Cold-War giants. India, still considered a developing country, stands tall among the nations shaping the cosmic commons.

And behind every rocket plume in India, are thousands of quiet dreamers who give impetus to these achievements. We read the headlines, but rarely do we hear the intimate stories of the men and women who labor to democratize space in India. A country struggling to give a better life to its growing middle class. We know little about the dreamers who are also doers organizing space camps, robotics challenges and always seeking novel ways in which they can make space a realm not just for a few billionaires, but for the billion people at the bottom of the pyramid.

In Jamaica we say, “**Wi likkle but wi Tallawah**” small in size, mighty in spirit. **Dr. Srimathy is a Tallawah woman.** Through these pages, we witness seven guiding principles that animate her life -

Purpose – a clear sense of why she is here.

Vision – an unshakeable picture of the world she longs to help create.

Courage – stepping out in faith when the path is dark, rocky, and lonely.

Perseverance – sustaining effort when every fibre is tested.
Hope – a spiritual force that keeps possibility alive.

Faith – trust in something larger than oneself when resources are scarce.

Love – a deep care for community and a conviction that space belongs to all humanity.

These qualities fuse emotional and spiritual intelligence - the ability to know oneself, to sense one's place in the vast cosmos, and to act from that understanding. Her journey also draws us into some of the great questions that now confront our Species - Who owns or governs extraterrestrial resources and territories?

How do we guarantee fair participation for all nations, avoiding new forms of Colonialism? What legal frameworks will protect the shared heritage of the Moon, the planets, and the Stars? Through Dr. Srimathy's lifestories, we begin to glimpse answers— as her lived experience. Her life illustrates how personal courage, and public purpose can converge to pioneer systems change. This book answers our question - "What compels a little girl in India to set her sights on the stars and claim space exploration as her reason for being? May her story light a spark of purpose in you as well. And may her story give you the courage to pursue your own vision and the perseverance and faith to remain on your journey even when it seems impossible. Above all, may her story help you to join her in making a difference that lifts humanity on this planet and among the stars. **Kwa Nyota. Ubuntu.**

About our Champion



Dr. Claire A. Nelson, Global Futurist and Catalyst-in-Chief for 1 million SMART Futures Movement, serves as a **Senior Advisor for Mission ShakthiSat**. Honoured as a **White House Champion of Change**, the self-described planetary steward, is Convenor of Space Ungana, and Open Africa Space Exploration Analogue Simulation. The self-described planetary steward serves as a **Global Goodwill Ambassador for UN International Moon Day**.

Ms. Shelli Brunswick

Space is no longer a distant dream; it is a **fragile frontier** where our choices will shape the future of humanity. Every launch, every satellite, and every discovery reminds us that we are not only explorers, but also stewards. The cosmos offers infinite opportunities, but it also demands responsibility, wisdom, and foresight.

The pages of this book challenge us to see beyond the technology and headlines. They ask us to confront the truth that space is not separate from Earth. It is deeply intertwined with our security, our environment, our economies, and our collective destiny. The same satellites that guide astronauts also help farmers predict droughts. The same innovation that fuels rockets can ignite new industries, new pathways, and new hope on our planet.

Yet, this frontier is fragile. It can inspire collaboration or foster conflict. It can expand access or reinforce inequities. It can become a bridge between nations and generations—or a dividing line. What determines the outcome is not the stars above us, but the decisions we make here and now.

This book is more than an exploration of outer space. It is a call to action. It reminds us that leadership, courage, and cooperation will define whether space remains a promise or becomes a peril. May these words inspire you to look upward with wonder and forward with responsibility to treat the fragile frontiers before us not as barriers, but as bridges to a more hopeful, united future. Best wishes to Dr. Srimathy kesan

About the Fighter



Shelli Brunswick is CEO & Founder of SB Global LLC, a global motivational speaker, author, futurist, and former senior executive in the space industry. Recognized among the **“Top 100 Voices for Our Planet”** and serving as Global Chair of the G100 Space Technology and Aviation Wing, she advises governments, organizations, and entrepreneurs worldwide on space innovation, leadership, and sustainability.

About the Author

Dr. Srimathy Kesan

Dr. Srimathy Kesan is the Founder & CEO of **Space Kidz India (SKI)**, an aerospace startup designing, manufacturing, and launching nano and micro satellites. She is the **only woman founder in the world** to have led **27 space missions**, includes **19 Balloon Satellites, 3 Sub-Orbital Payloads, and 5 Orbital Satellites**—mostly student-driven.



Her landmark achievements include **KalamSAT**, the world's first 3D-printed satellite launched by NASA, and the historic **AzaadiSAT**, uniting 750 rural girls from Kashmir to Kanyakumari to build a satellite launched aboard ISRO's SSLV in 2023. She also directed **Mission ShakthiSAT**, a milestone women-led student satellite mission.

Beyond technology, Dr. Kesan has transformed STEM education and youth empowerment, inspiring over a million students through initiatives like Young Scientist India, and serving as the only Indian Ambassador at **NASA, ESA, and GCTC space camps**. She was the only woman from India to **fly on a Zero Gravity mission**, led cultural-scientific missions carrying the Indian flag and Bhagavad Gita to near space, and was invited to share the dais with the legendary **Stephen Hawking**, a rare and unforgettable honor. She has

also received accolades from India's **President** and **Prime Minister**, further affirming her impact and legacy.

A visionary leader, she embodies **resilience, innovation, and inspiration**, empowering the next generation to dream beyond Earth.

Editorial Researcher Iruthayaraj M

Iruthayaraj M is a Physics graduate from Loyola College, Chennai, whose journey has been shaped by curiosity and a deep love for learning. With a strong passion for science, space exploration, and knowledge-sharing, he has carved a path as an Editorial Researcher, blending analytical thinking with storytelling.



He currently serves as the Administrative Manager at **Space Kidz India (SKI)**, a pioneering organization in the aerospace and defence sector that has led multiple student satellite missions and fostered international collaborations. Alongside his administrative role, his work in editorial research contributes to documenting, curating, and presenting ideas that inspire young minds and make complex subjects accessible to wider audiences.

Writing and research have become natural extensions of his vision to share knowledge. As a researcher, he aspires to encourage readers to dream bigger, think deeper, and embrace challenges as stepping stones to growth. He believes that education is not confined to classrooms but is a lifelong journey of discovery and transformation.

This book reflects his experiences, insights, and aspirations, blending his academic foundation from Loyola College with his professional journey at Space Kidz India. It stands as a testament to his commitment to creating meaningful impact through words, ideas, and research.

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“When I looked out and saw the Earth, that tiny blue marble, I realized how connected we all are.”

— Valentina Tereshkova, First woman in space..

“She carries galaxies in her spirit and strength in every step, “Across borders, across skies — Shakti flows where women dare.”

— Team Mission ShaktiSAT

