CRITICAL STEPS
IN SPACE TECHNOLOGY DEVELOPMENT

by

Adigun Ade ABIODUN
Adviser to the
Nigerian Delegation to COPUOS

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OUTLINE

- The need for this dialogue
- Categories of participation in SST
- Critical Steps -National Strategy
- Learning from the experience of others
- Contractors, Consultants & Turn-Key Projects
- National Commitment
- Conclusion

The Need for this Dialogue

- **Unlike the standard industrial technologies…., mastery over new sciences and technologies requires high expertise in the relevant basic sciences.**
- **Experience has shown that high technologies cannot simply be transferred.**
- **The notion that it would be possible for the South to obtain them from abroad without the development of an indigenous broad-based scientific and technological infrastructure is mistaken.**

The Challenge to the South (1990). **<u>The Report of the South Commission</u>, Oxford University Press, New York**

Categories of participation in SST

Space Technology Development Models (1)

1. Space-faring

- Countries that have acquired launch capabilities and continue to successfully develop, design, build and launch their own satellites, space vehicles & ancillaries.

2. Space-capable

- Countries that are able to develop, design and build their own space assets, including satellites. A number of these have opted not to go for launch facilities while others are developing theirs.

Space Technology Development Models (2)

3. Space-aspiring

- Countries that have sought external cooperation in the co-development, co-design and co-building of their satellites; they may also aim for launch capability in the future.

4. Space-aiming

- Countries that have purchased their own satellites from the open market as a turn-key project; and countries that may not yet be financially endowed to embark on an SST programme as a manifestation of their space aspiration. However, a number of these may be undertaking astronomical studies, balloon experiments and sounding rocket research.

Space Technology Development Models (3)

- ***The existing legal instruments that today govern human exploration and utilisation of outer space,***
- ***Inter-Agency Space Debris Coordination Committee (IADC) and its Space Debris Mitigation Guidelines*, and**
- **The *Global Exploration Strategy: The Framework for Coordination (GES-FC).***

- **The above three instruments and documents were developed principally by those countries in categories 1 & 2 who are the industrial countries of today.**

Global Exploration Strategy (GES-FC)

- **GES-FC is a voluntary mechanism and the international coordination process is open to new participants**
- **Each country will bring its own perspectives and skills and, in return, will gain access to the common knowledge and experience.**

Globally coordinated efforts in space will include:

- **Solving global challenges, such as *climate change and management of risks and dangers posed by asteroids and space debris* in space and on Earth through innovative technologies;**
- **Permanently extending human presence into space,;**
- **Economic expansion and new business opportunities;**
- **Creating global partnerships by sharing challenging and peaceful goals; and**
- **Inspiring society through collective efforts and personal endeavours.**

Nurturing SST in the Developing Countries

- **Objectives of the 1979 UNESCO Workshop in India.**
- **Its Outcome – <u>Construct</u> a *Giant Equatorial Radio Telescope (GERT)* that would provide the inquiring minds of the South with unqualified challenges and opportunities to participate in fundamental research in the frontier areas of astrophysics, cosmology, space physics and extra-terrestrial phenomena.**
- **<u>Establish</u> an *International institute for space science and electronics (INISSE)* that can lead to the development of an indigenous, broad-based, scientific and technological infrastructure that is based on:**
  - **Competence building in such areas as microwave and antenna systems, space applications technology including satellite systems, radar and digital electronics including computers, microprocessors and information technologies, robotics, etc.**

Mastering New Sciences and Technologies

The Ooty Radio Telescope

CRITICAL STEPS

for Nurturing SST Development in the Developing Countries

Critical Steps – Phase 1

- **Home–grown National Strategy Sessions:**

Who is involved?

- **Made up of all interested parties (government, academic, research and financial institutions, the private sector and relevant professional NGOs);**

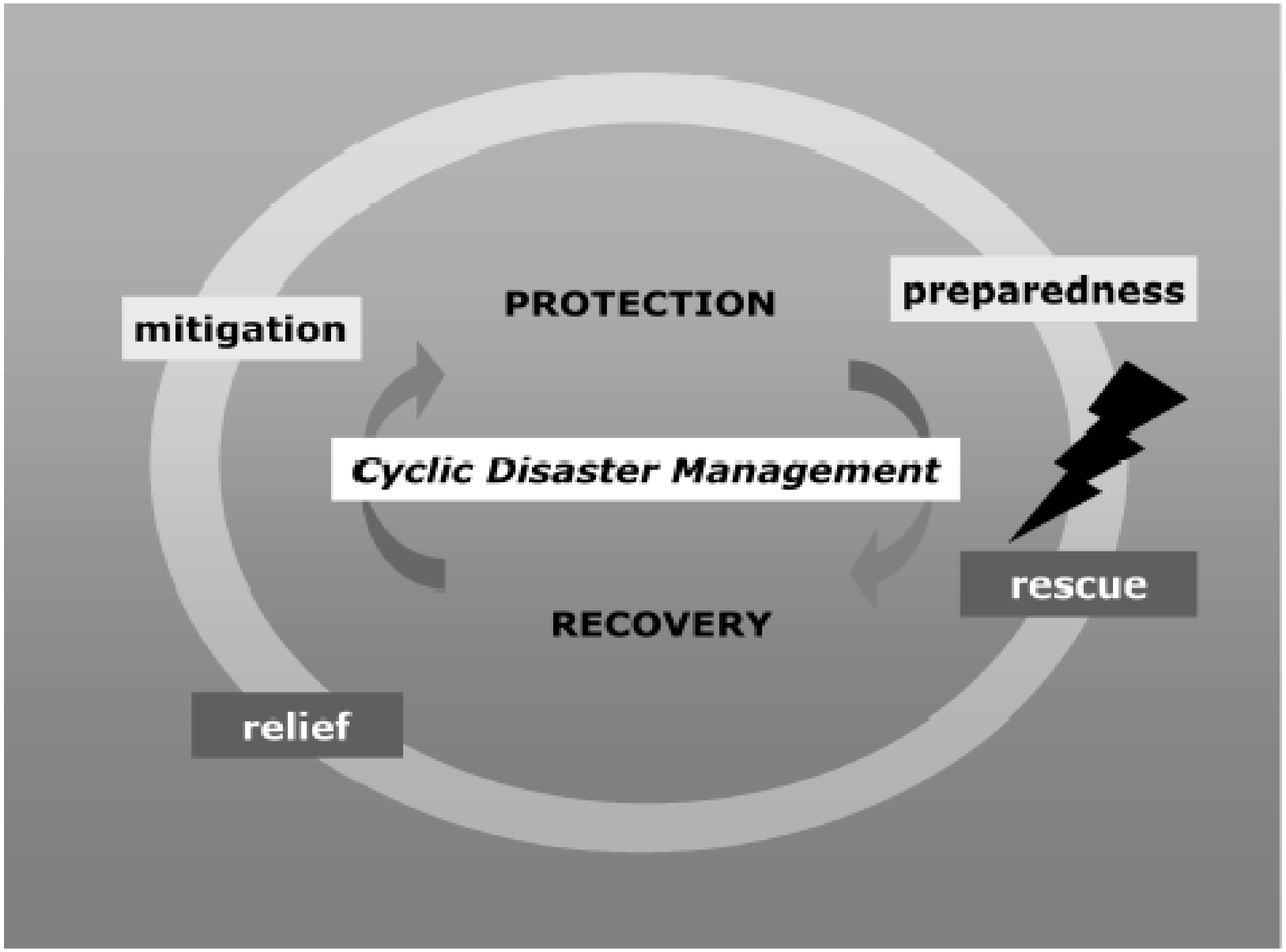
What is your purpose?

- **To deliberate on why your country needs to embark on a Space Science and Technology (SST) Mission.**

The Justifications

Our Life Support Systems

Satellite Technology (Communication GPS & Remote Sensing) and GIS in Disaster Mitigation



Peace and human security

Vela Satellite (USA)
September 22, 1979

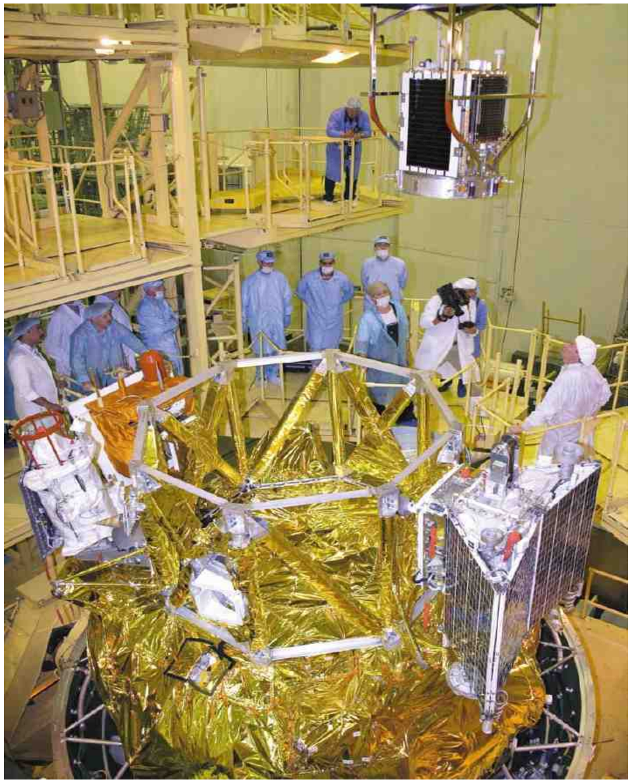
A single landmine might cost $1, but once in the ground, locating it and making it safe can cost up to $1000.

Long-term sustainability of space activities (Asteroids & meteorites)

Collective responsibilities

- **Today, no global entity is responsible for the management of international space traffic;**
- **There is also no global mechanism for sharing space awareness information among all member States with space assets.**

Development of Science and Engineering Capabilities



Critical Steps - 2

DRAFTING THE BLUEPRINTS:

- **Vision**
- **Space Policy**
- **Assessment of what is on the ground**

Address how to:

- ❑ **Promote a national space industry**
- ❑ **Enhance space awareness at all levels nationally**
- ❑ **Collaborate at the regional and international levels**
- ❑ **Determine the need for an SST lead organization**
- ❑ **Plan the search for & appointment of the national "Space Shepherd"**
- ❑ **Understand the nature and scale of the national commitment**
- ❑ **Assess whether you build or buy**

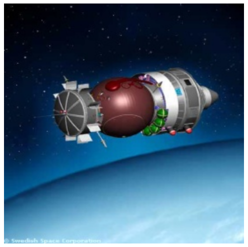
Learning from others on Nurturing of SST Development

Esrange - Swedish Space Corporation

- Researchers and technicians from around the world work together here, carrying out scientific experiments as well as tests for commercial applications within a wide range of disciplines:

- Controlling TV signals broadcast;
- Conducting experiments that promise better medicines and materials in the future;
- Carrying out important research on the Earth's changing climate;

- In the civil facility in the world that receives most data from Earth observing satellites including Data that might end up in your GPS or your atlas.



- And tests landing systems for space shuttles, parachute systems, communication equipment and an array of different space-bound sensor systems.

International Space Station (ISS)

- ISS is the most ambitious experiment in peacetime international scientific and technological cooperation ever attempted

Experiments on-board ISS (2)

- **Countries with ISS experiments include:**
  - USA
  - Russia
  - ESA (10 Countries)
  - Canada
  - Japan
  - Brasil ****
  - Malaysia *****

- **Objective :**

  To help improve our daily lives here on Earth

- **Focus of Experiments:**
  - Healthcare,
  - More efficient processes in industry
  - Advanced high-performance materials for automotive, medical and industrial applications.
  - Agricultural experiments on hybrid seeds;
  - Variety of experiments focusing on astronomy, biology, meteorology and physics.

Tools for knowledge development

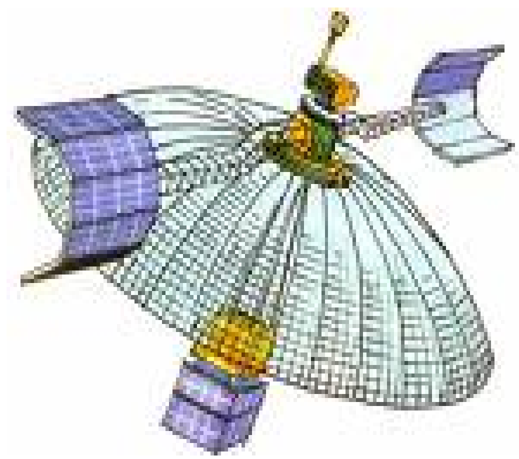
Private Sector Investments in Space (1)

- **The Physical Research Laboratory (PRL):**
  - **Cradle of space science in India;**
  - **Founded by Dr. Vikram Sarabhai on November 11, 1947 by persuading charitable trusts controlled by his family and friends to endow a research home in Ahmedabad.;**
  - **Initial focus of PRL were on Cosmic Rays and the properties of the Upper Atmosphere;**
  - **Today, fundamental research areas include Space and Atmospheric Sciences, Astronomy, Astrophysics & Solar Physics, Planetary and Geosciences.**

Satellite Instructional Television Experiment (SITE)

- **Objectives:**
  - Educate the poor people of India on various day-to-day human issues and experiences via satellite broadcasting, and
  - Help India gain technical experience in the field of satellite communications.
- **Duration:** It ran for one year from August 1, 1975 to July 31, 1976, and was produced by All India Radio and broadcast by NASA's ATS-6 satellite stationed above India,
- **Outcome:** It was successful, as it played a major role in helping India develop its own

ATS-6 Satellite



- The project also showed that India could use advanced technology to fulfill the socio-economic needs of the country.

Private Sector Investments in Space (2)

- "You can import coal and machines, but you cannot import talent,“ “We need a world class research institution.”
- Established in 1986, by Pohang Iron and Steel Company (POSCO) and POSTECH founding chairman, Tae-Joon Park & Prof. Professor Hogil Kim, the founding president of POSTECH;
- Initial focus was on engineering sciences and ferrous technology;
- It has added other fields such as bio-technology, nano technology, and robotics.

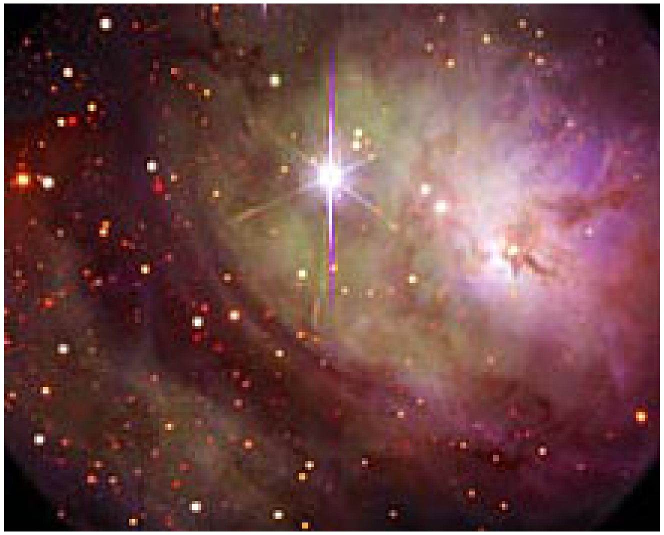
Early SST efforts in South Africa (1)

- **In 1958, NASA installed antenna at Hartebeesthoesk as part of its global telemetry system.**

- **It was used to control many unmanned deep space missions such as the *Lunar Orbiter*, the *Mariner* missions that explored the planets *Venus* and *Mars* and the *Pioneer* missions that monitored the solar wind in deep space.**

- **When NASA no longer needed the station, RSA converted the station in 1975 into a HartRAO Radio Astronomy Observatory. That experience led to the building of Southern African Large telescope (2005) and the on-going competition for SKA.**

Southern Africa Large Telescope (SALT), inaugurated on November 10, 2005 in Karoo, South Africa



The Lagoon Nebula (Central Regions) – One of the first images of SALT

Early SST efforts in South Africa (2)

- In the 1980s - An increasingly isolated apartheid regime developed a military spy satellite (GreenSat) and the means to launch it. This effort resulted in the development of satellite engineering capability at Stellenbosch University (SU)

- 1999 - Students and their Professors at SU developed a microsatellite- SunSat, launched by NASA in 1999.

- 2007 – The RSA government funded the development of a second microsatellite: the 81-kg SumbandilaSat which was built by Stellenbosch University spinoff company, SunSpace and Information Systems.

Other Kinds of Lessons

Other Lessons (1)

- For those that have acquired their micro-satellites from the open market, it is becoming apparent that the route to indigenous capability development in space may demand a different approach:
  - First, you invest in the enabling technologies. Because an initial mastery and deployment of the enabling technologies at the local level is an indispensable part of space aspiration;
  - Competition even in your own backyard from the commercial market - Enhanced radiometric, spatial, spectral and temporal resolutions and data availability on demand are major factors.

Other Lessons (2)

Issues with Consultants, Contractors and Service Providers:

Are you getting value for your money?

- ***Are your scientists and engineers:***
  - **Contributing to the S&T development and construction of the project you are paying for or are they observers?**
  - **Involved in the ground receiving station development, construction and installation as well as its subsequent operation and management? and**
  - **Are there proprietary constraints, such as the absence of source codes needed to modify a particular software, or the rights of your institution or engineers to all your inventions?**
- **Be weary of contractors and service providers that are interested in helping you to get to the moon when you cannot even independently develop and build any machine that operates on terra firma.**

Other Lessons (3)

- Your focus should be on technology development at home. Because every S&T purchase agreement you enter into abroad only goes to enhance the technological capability of your contracting company and the job security in the company and in its own home base.

ASK : The Law & The Court

- The Agreements you entered into with your contactors/consultants/suppliers shall be governed construed and performance thereof shall be determined in accordance with the laws of which country?

- The courts of which country shall have jurisdiction over this agreement in case of any dispute(s)?

National Commitment – Fundamental to SST Nurturing

Back to the Drawing Board

- **Reflect on and draw lessons from:**
  - ❑ **The experience of others; AND**
  - ❑ **Reflect same, as appropriate, on the Justifications and Strategies Outlined in your BLUE PRINT & Drafts on "Critical Steps"**

- **Review and amend your drafts as appropriate.**
- **Ensure a long-term national commitment.**

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CONCLUSION

- Participation in the space enterprise does not necessarily require a physical presence out there in space with satellites/space vehicles; it also does not require that a given country should be able to deploy payloads in space with its own roaring rockets.

- The critical issues are the nation's commitment to a specific aspect of the space enterprise in which it wishes to make its mark and make a difference and its long-term determination to appropriately utilise its current and potential capabilities to achieve that objective.

- At the outset, there is the indispensable need for fundamental research and associated mastery of basic and new sciences and technologies. There are also many "niches" that the space-aspiring and space-aiming countries of today could assess from the perspectives of their own long-term interests.

- Following this or similar approaches will certainly result in a highly nurtured space science and technology development in any given society including its associated long-term rewards.

Thank you
for
your attention