



# CAPACITY BUILDING FOR SMALL SATELLITE MISSIONS IN INDIA



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# Introduction

- Founded in 2012
- Previous experience
  - SRMSAT
  - Velox P
  - StudSAT

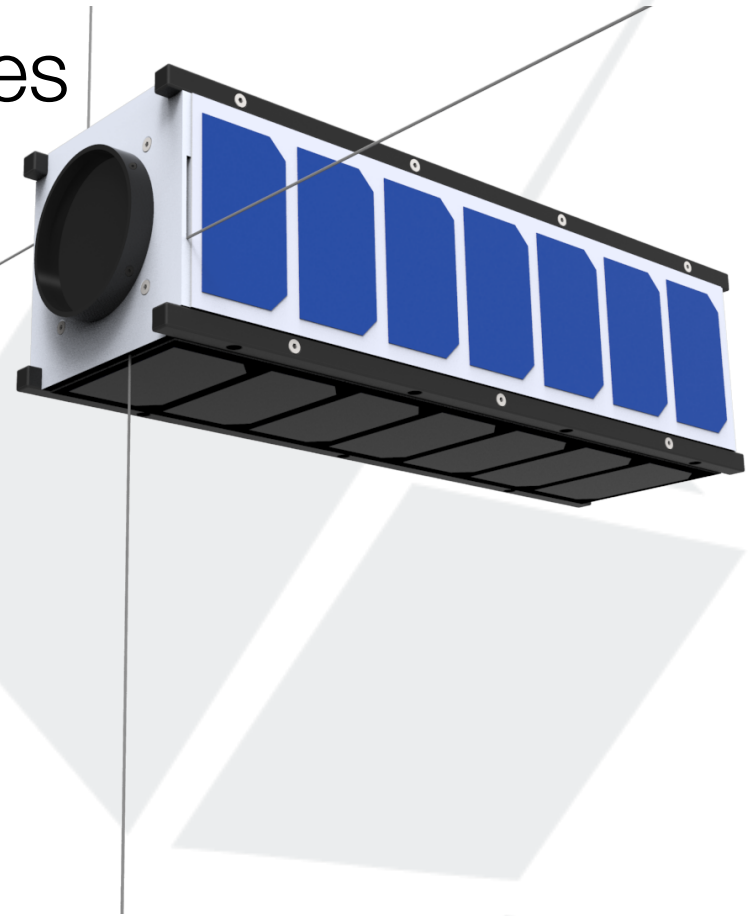


# Introduction

- Privately Design & Develop and Operate Small Satellites in India
  - EO Solutions
  - Industry Analytics
- Explore data downlink services
- Strategic Partners
  - Berlin Space Technologies
  - Noorul Islam University

# Space Segment

- Nano/Micro Class Satellites
- <5m resolution EO
- Live video capability
- Scheduling/Leasing



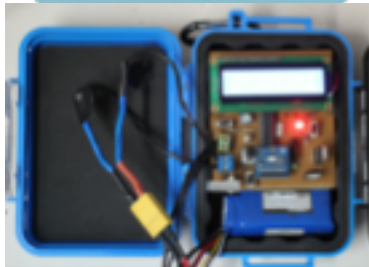
# Ground Segment

- VHF/UHF (GENSO Compatible)
- S Band (3.2m dish)
- Downlinking Services (NanoSatisfi)

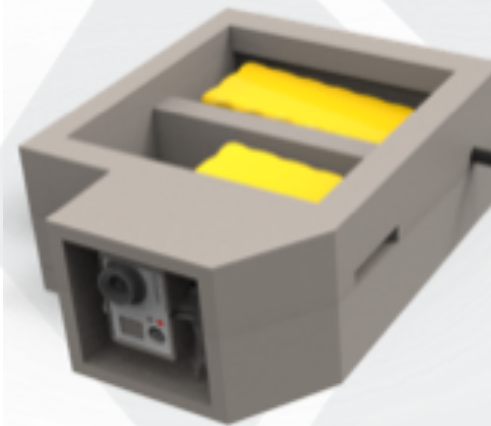
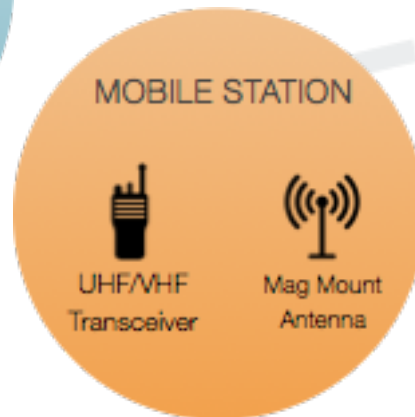


# Ballooning

- Experience in Arctic and India
- ~10 balloon flights in India



CUT DOWN PACKAGE



HAB-X Package



# Outreach



Yuri's Night India 2013  
Birla Science Center, Hyderabad



Workshop Partner  
IIT Kharagpur



SpaceUp India 2012  
PES Institute of Technology, Bangalore



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### Moore's Law in Space

Mainframes | 4000 Kg



1970's

PCs | 1000 kg



1980's

Laptops | 1000 kg



1990's

Smart Phones | 10 kg



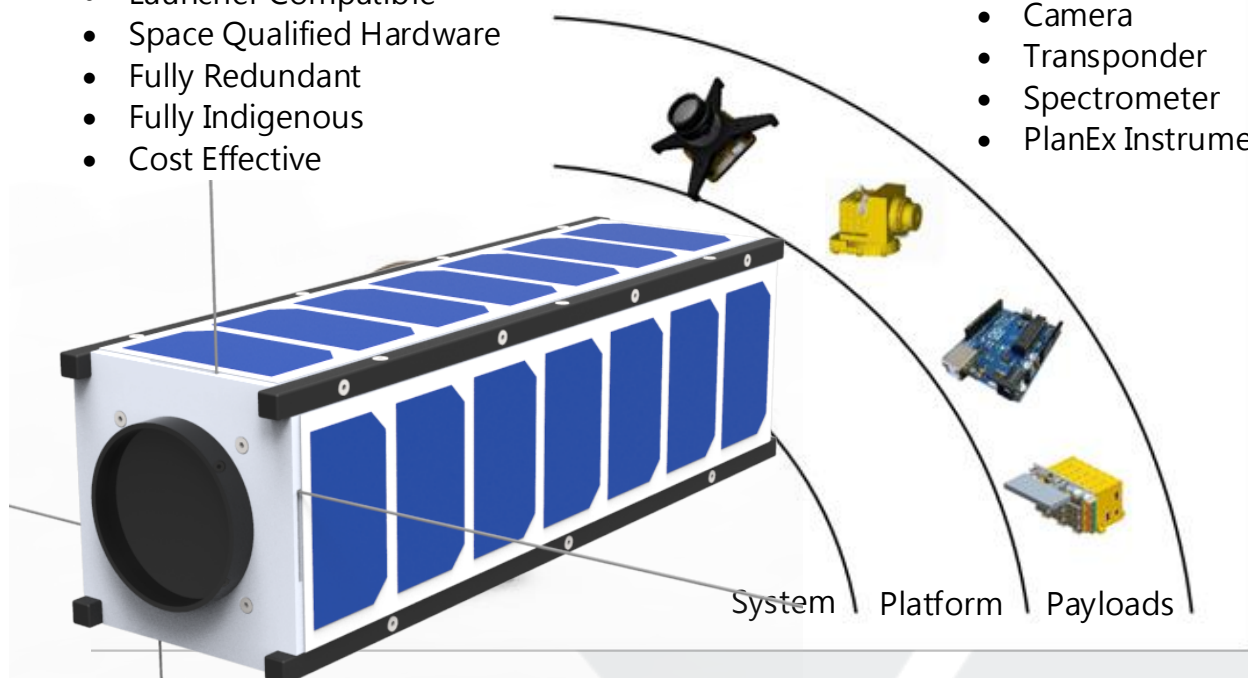
2000-Current

### System Features

- Launcher Compatible
- Space Qualified Hardware
- Fully Redundant
- Fully Indigenous
- Cost Effective

### Payload Examples

- Camera
- Transponder
- Spectrometer
- PlanEx Instruments



### Platform Features

- Plug & Play Architecture for Multiple Payloads
- Standard Interfaces with Open Architecture
- Fully Customizable for Payload Developers

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# J. Bouwmeester et al., 2010

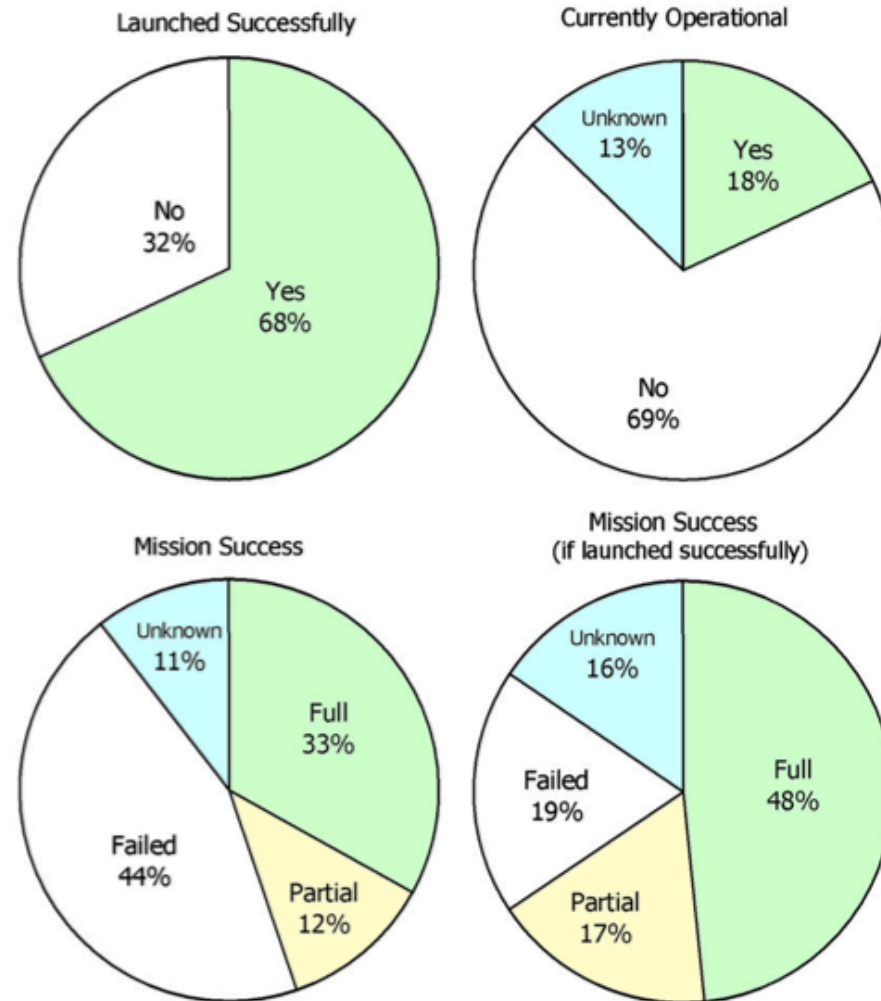


Fig. 4. Success rates of pico- and nanosatellites.

# J. Bouwmeester et al., 2010

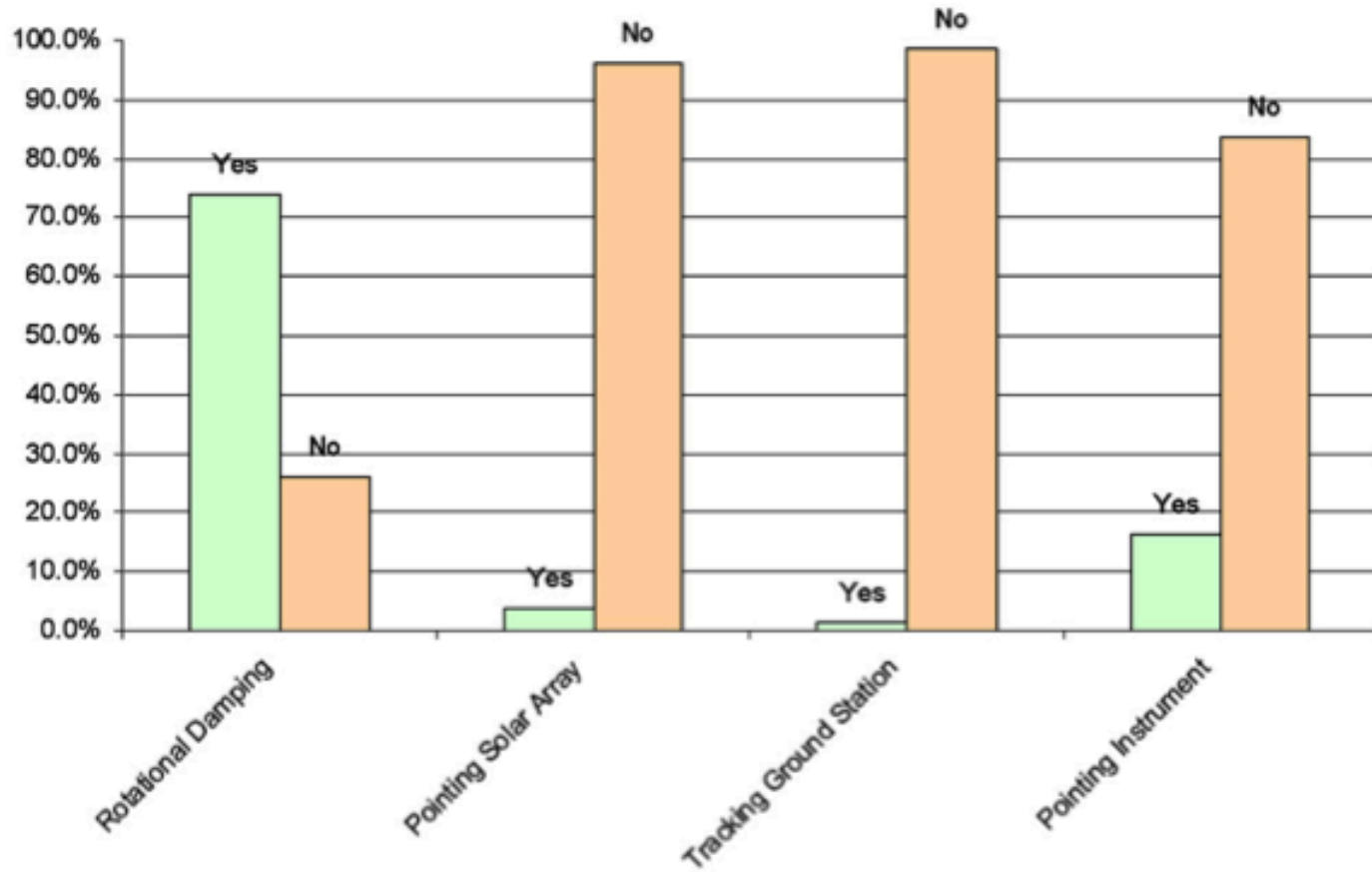


Fig. 8. Attitude control objectives.

# J. Bouwmeester et al., 2010

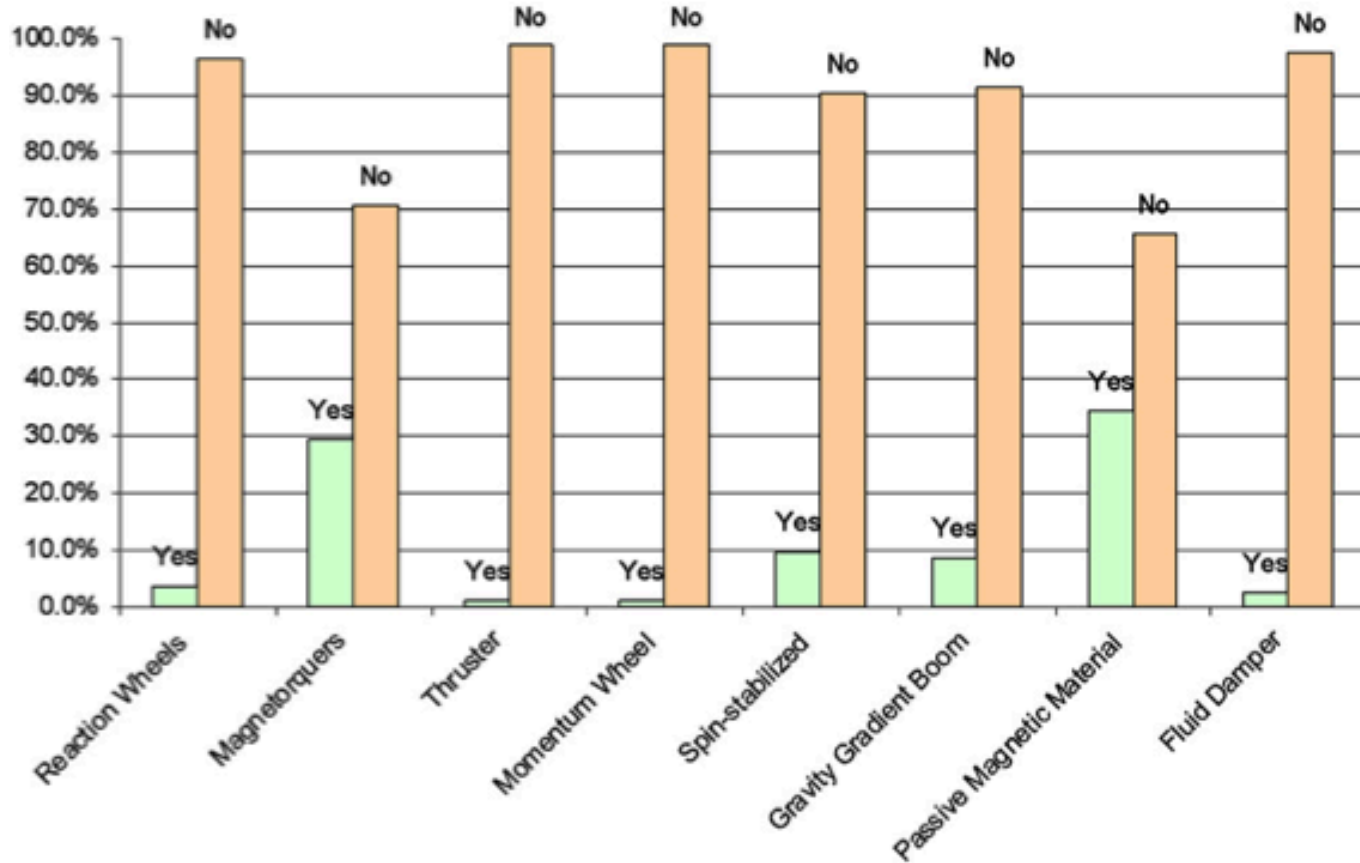


Fig. 10. Onboard attitude actuators or stabilizers.

# Advantage India

- ISRO Expertise
- ISRO Hardware
- Testing Facilities
- Launch Facilitation
  
- Leveraging the Advantage
  - Building bigger (~10-15kg)

# Small Satellites? How Small?

- Engineering the bus or Facilitating the Application?
  - The ISRO way!
- Value societal needs
  - Educational experience great
  - Educational experience + Delivering to need better
  - Can clear funding issues

# Do Not's of University Missions

- Large Teams
  - Large conglomerates
  - Large Teams
- Building everything for experience
  - Realization of 100% subsystems in house often in 3<sup>rd</sup> mission
- Greater timeline
  - Students graduating / No mechanism of retaining
  - Chinese whispers effect

# Do Not's of University Missions

- Investing in Infrastructure
  - Eg. TUBSAT-A [35kg, Launch 1991]
    - No Clean Room
    - Vibration Testing on German Streets
    - Satellite Stored in Photocopy Machine Room
    - No subsystem redundancy
- Shelving of your development
- Students with experience not feeding the right industry

# Nominal Approach

- Realize a bus in a Class
  - CubeSat
  - Nano Class
  - Micro Class
- Common Avionics
  - Replicating the bus
  - Improving performance of particular subsystems



# Suggestions

- Exploiting the power of constellations (temporal) for societal applications
  - Eg. Communications, Wireless Sensor Networks
- Networking of Ground Stations
  - Common platform
  - Common database



THANK YOU!



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