A “Small” Satellite Revolution

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Student Satellites: Education Tools

Multidisciplinary!!

System Integration & Testing

Subsystem Development

Spacecraft Design

Systems Engineering Training Tool
CubeSat Program Objectives

- Started in 1999: Stanford-Cal Poly Team
- Facilitate Access to Space:
  - Rapid Development Time (1-2 years, Student academic life)
  - Low-Cost
  - Launch Vehicle Flexibility
- Use Standards
- University Projects
- Industry Testbed
CubeSat Standard

- PicoSatellite (Small)
- Simple Standard
  - Manageable by universities

- P-POD Deployer
  - Protect Primary & Launch Vehicle
  - Launch Vehicle Flexibility
  - Simplicity
  - 3 CubeSats (or 3U spacecraft)
RESULTS

From Design

SUCCESS !!

To Spacecraft
To Testing

To Integration

SUCCESS !!!!
To Operations

Photograph taken by AeroCube-2, April 17, 2007
CubeSat in Education

- Constraints = Creativity Engines
  - Encourages new thinking
  - Lack of experience can be a plus

- Ideal Workforce Development
  - High Student Motivation
  - Systems Integration Training
    - High tech skills not just aerospace
  - Community = Support Network
  - Launch Opportunities

- Great Entry Point
Status

- 44 CubeSats in LEO (63 Launched)
  - 14 Launches (US, India, Russia)
  - Regular Launches Now Available

- Large Developer Community
  - University/Gov/Industry
  - Worldwide
  - Dedicated Workshops

- NEW PLAYERS!!
  - New Countries
  - New Universities
Beyond Student Projects

- Worldwide Support of CubeSat Activities
  - NSF, NASA, DoD, ESA, JAXA, IAF, . . .

- Scientific CubeSats: NSF Space Weather, ESA QB50, NASA Astrobiology

- DoD CubeSats: Air Force SENSE, NRO Colony, Army SMDC ONE

- Developing CubeSat Industrial Base: Pumpkin, ISIS, Tyvak, GomSpace, Sequoia (Colombia)
CubeSat is Successful Standard

Why?

- Small & Low-Cost
  - Many Developers
- Standardization
  - Developer Community
- Innovation and Creativity
  - New Players
- Commercial Electronics Advances
- Launch Opportunities
  - Primary Payload and Launch Vehicle Protection
- Risk-Posture Change
CubeSat: Revolution or Evolution?

- **Evolution:**
  - Smaller Spacecraft

- **Revolution:**
  - New Way of Doing Space Business
    - Higher Risk Tolerance
    - More Flexible Launches
    - Higher Production Numbers
    - Lower Cost / Complexity
Conclusion:

- CubeSat is Successful Standard
- Capability is increasing quickly
- Small barriers to entry
- Creative/innovative solutions required
- Perfect Workforce development tool
- Missions beyond education
Thank You
Questions?
www.cubesat.org