

*University-Class Spacecraft  
by the Numbers:  
Success, Failure, Debris.  
(But Mostly Success)*

**Michael Swartwout  
Clay Jayne**

*Parks College of Engineering, Aviation & Technology  
Saint Louis University*

30<sup>th</sup> Annual AIAA/USU Conference on Small Satellites  
11 August 2016



**SAINT LOUIS UNIVERSITY**

**PARKS COLLEGE OF ENGINEERING,  
AVIATION AND TECHNOLOGY**

# Gotta Catch 'Em All



- These charts, plus live & downloadable versions of all plots and the table are available **right now** at:

<https://sites.google.com/a/slu.edu/swartwout/smallsat2016>

- Please read the paper; there's no time to cover it all in 13 minutes
- This is not my CubeSat talk (though that data is on my website, too)



- Summarizing my paper from 2013

*... and 2011 ... and 2009 ... and 2007 ... and 2006 ... and 2004:*

1. “University-Class” = designed, built, tested and operated by students
2. There sure are a lot of university-built spacecraft!  
(And more are on the way!)
3. These years were very important:  
**1981** (UoSAT-1)  
**2000** (JAWSAT)  
**2012** (Attack of the CubeSats)
4. There are universities, and there are Universities:
  - a) Flagship
  - b) Prolific independent
  - c) Hobbyists

*“That’s neat; but why do we need another paper from you?”*

## Three big questions

1. Do these missions matter (on their merits)?
2. Are university-class missions worth the investment?
3. What are the risks/costs of university-class missions?

# University-Class Missions (2000-2015)

---



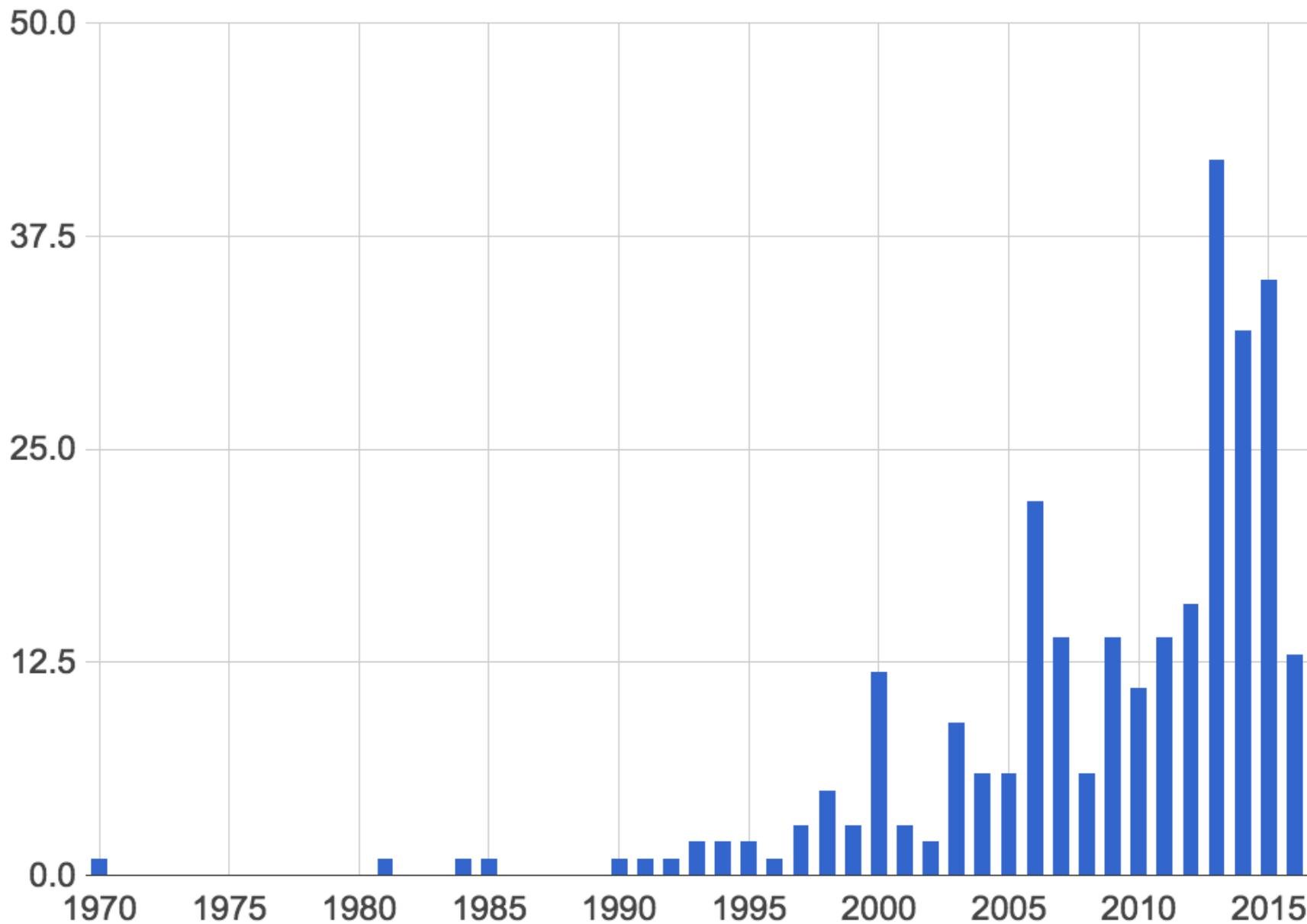
# Homework!



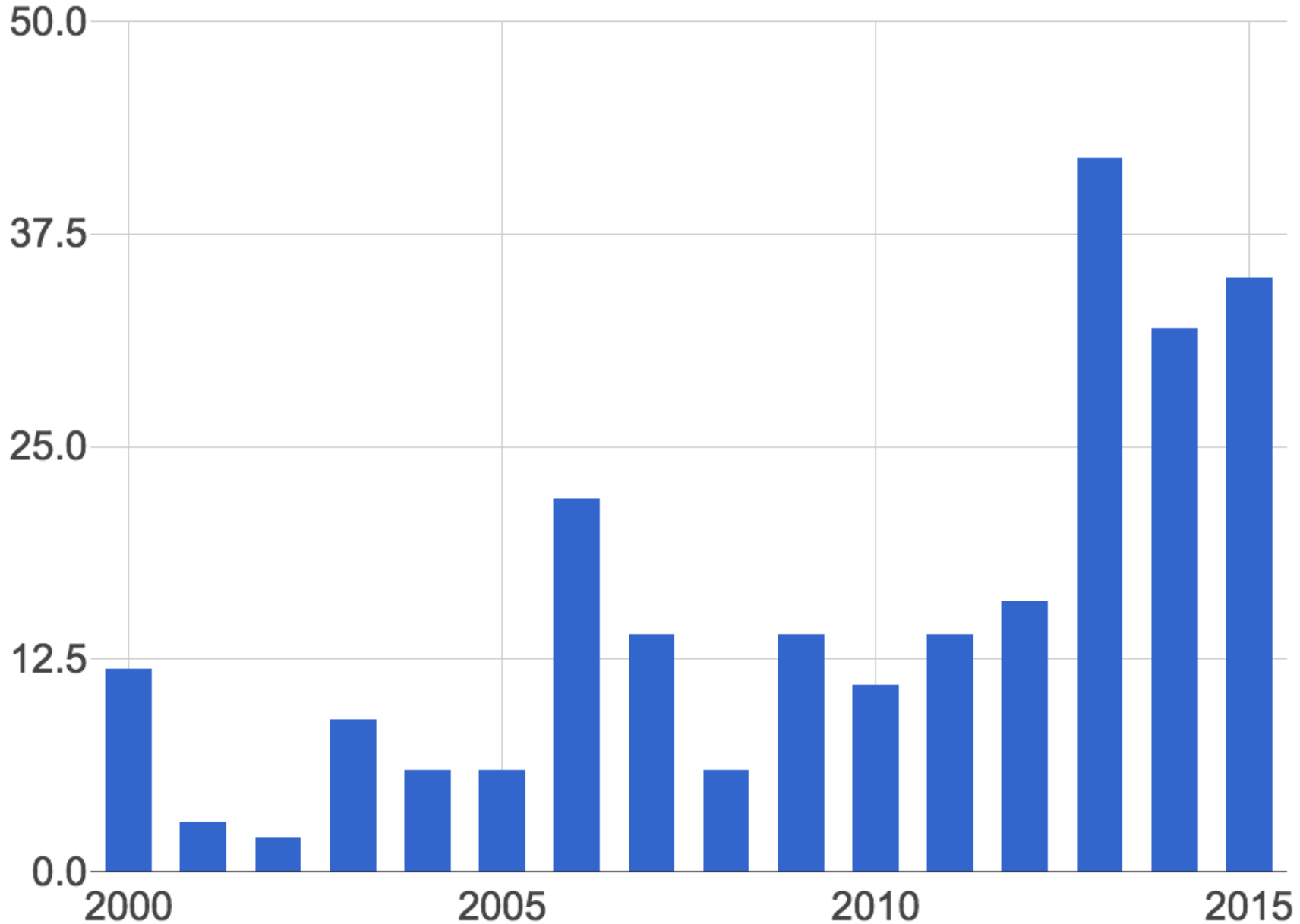
Iridium	Roton
Globalstar	Athena
Teledesic	QuickReach
Odyssey	K1
Ellipso	Priboi
ICO	R2150
Astrolink	Eclipse Express
STARSYS	Conestoga 1229
LEOCOM	Eaglet
ARIES	Intrepid



# University-Class by Year

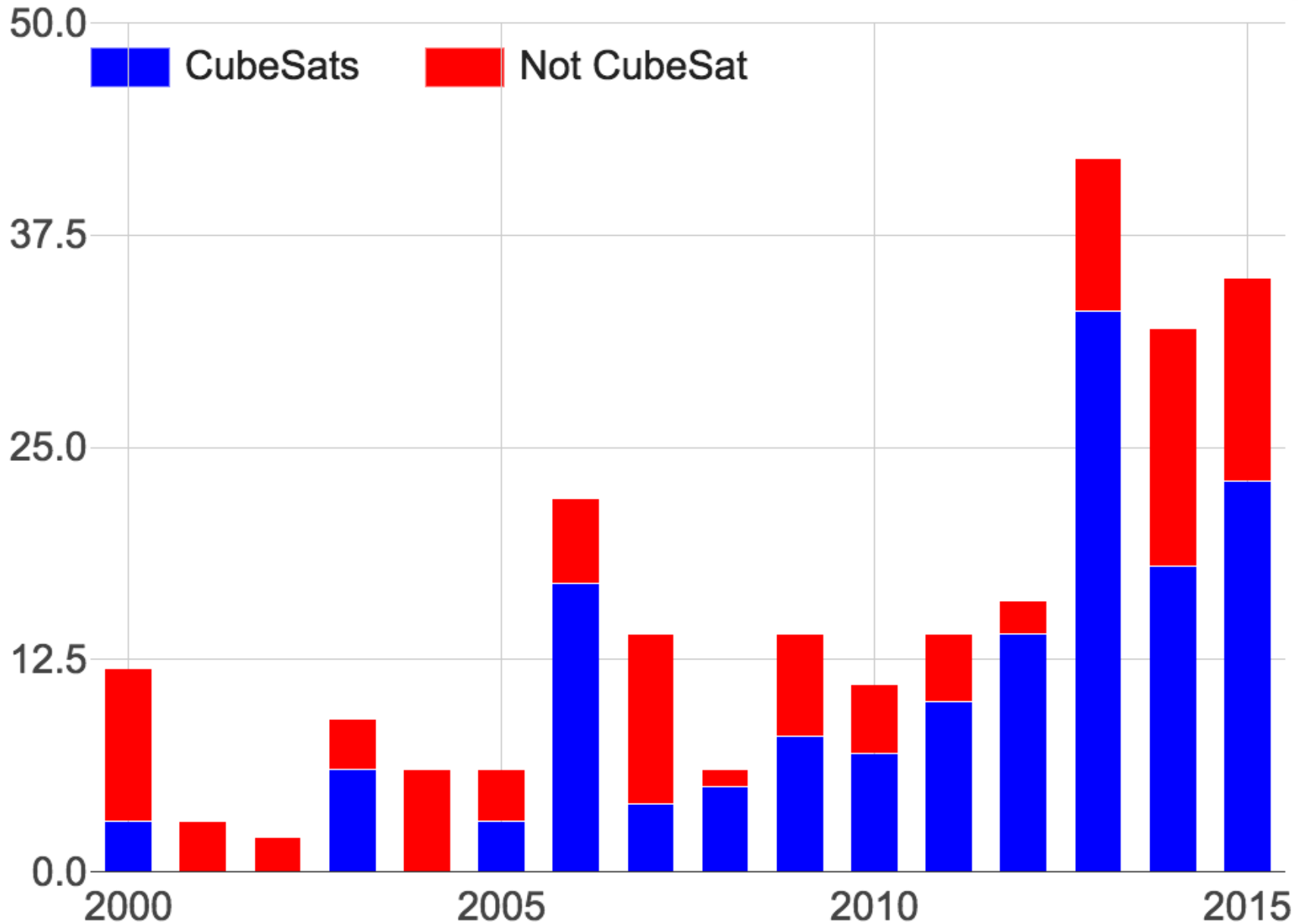


# University-Class by Year





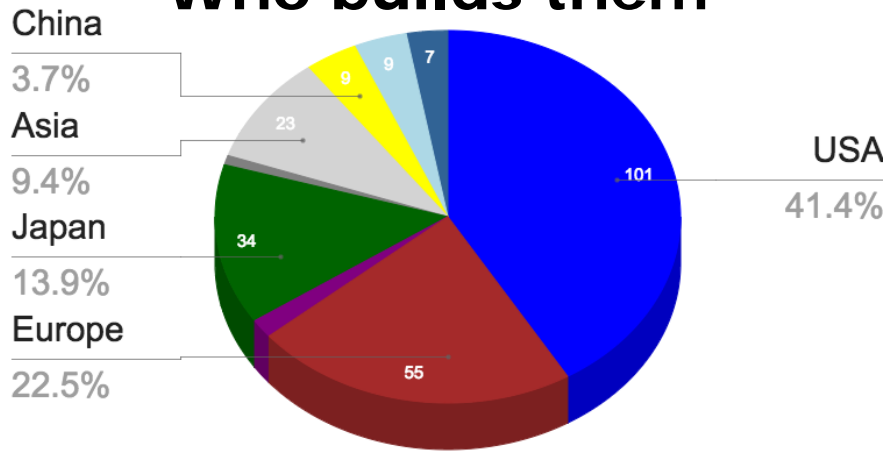
# It's Not Just CubeSats



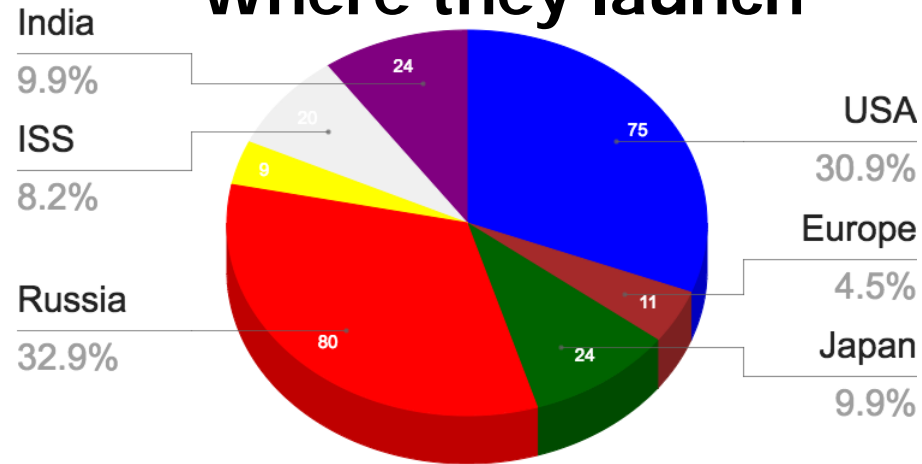
# All the World's a (Launch) Stage



## Who builds them



## Where they launch



## Communications

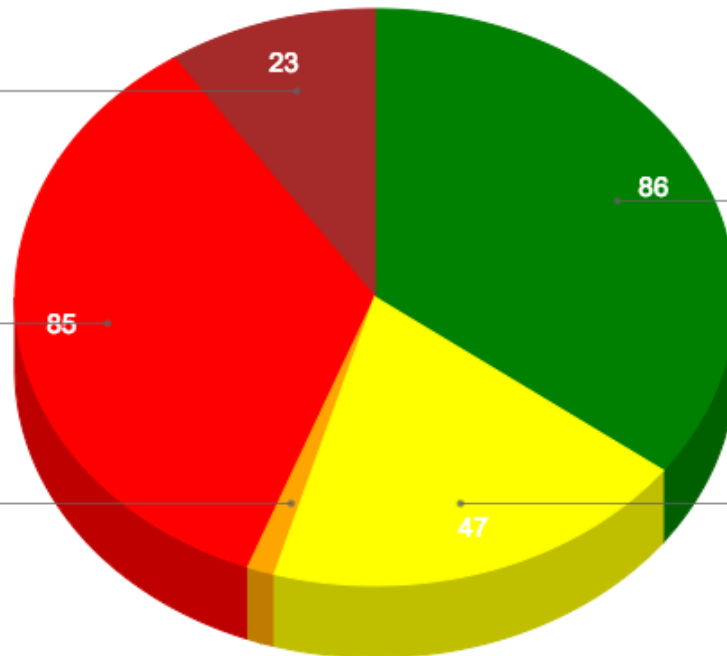
9.4%

## Tech Demo

34.8%

## Earth Imaging

1.2%



## Education

35.2%

## Science

19.3%

# What they do



# It Helps to Be Somebody (but not as much)



50.0

Flagship Prolific Independent Other Independent

Flagship (39): National investment  
Independent (84): Not Nationally Invested  
Prolific Independent (9): 4+ Flights  
*[30 other schools have 2-3 flights]*

25.0

12.5

0.0

2000

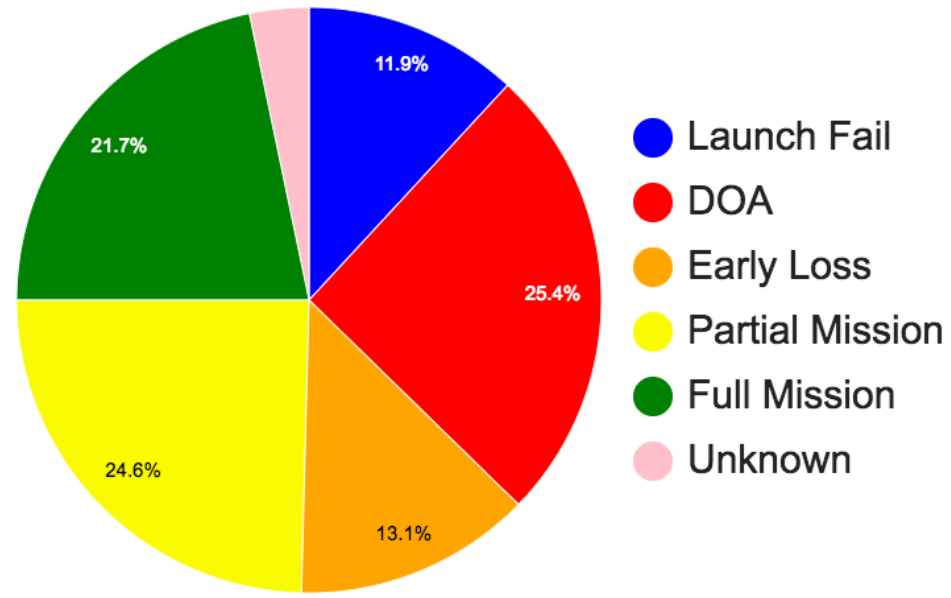
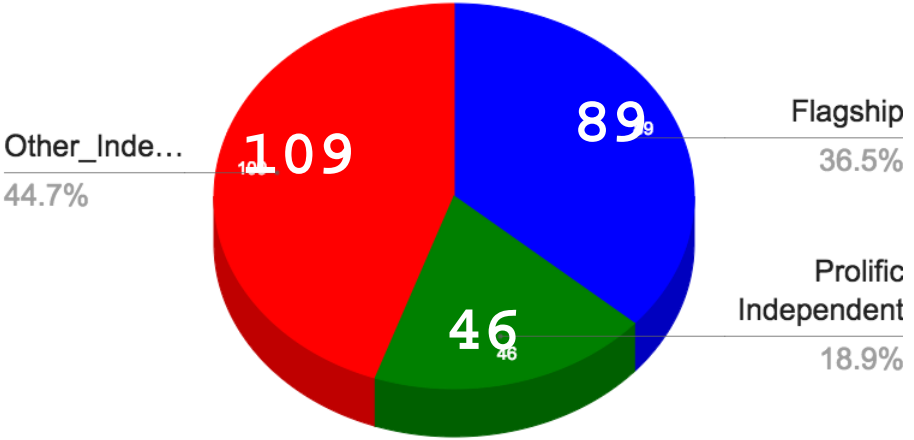
2005

2010

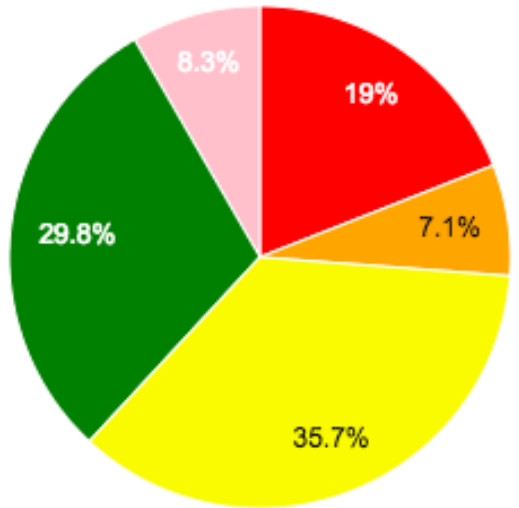
2015



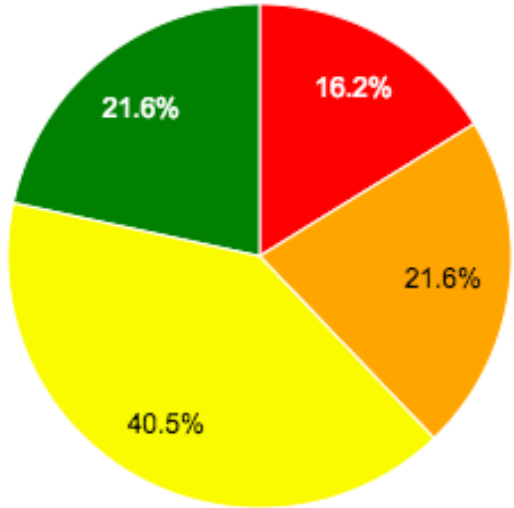
# Do that voodoo that you do so well...



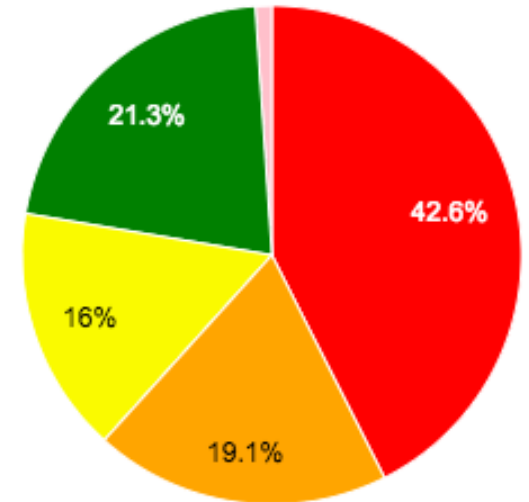
**Flagships**



**Prolific Independent**



**Other Independent**



# So What?



## 1. Do these missions matter (on their merits)?

*Yes: Publishable data,  
Technology infusion  
Reducing the fear factor*

## 2. Are university-class missions worth the investment?

*Maybe? Consider the cost (and heartache)  
80 of 132 schools have only flown once  
22 have only flown twice*

## 3. What are the risks/costs of university-class missions?

*We need to talk*



- Census Data Sources
  - Public: Gunter's Space Page (international launch log)
  - Public: Jonathan's Space Report (orbital elements)
  - Public: DK3WN Satblog (university/amateur operations)
  - Public: Union of Concerned Scientists (operational status)
  - Public: Program websites, conference presentations
  - Public: Bryan Klofas (communications/operational status)
  - Private: Personal communications
- All of these brilliant people who made university-class programs possible (AFRL, NASA, NSF...)
- Research support
  - AFOSR / UNP (original work)
  - NASA NEPP (ongoing)

*University-Class Spacecraft  
by the Numbers:  
Success, Failure, Debris.  
(But Mostly Success)*

**Michael Swartwout  
Clay Jayne**

*Parks College of Engineering, Aviation & Technology  
Saint Louis University*

30<sup>th</sup> Annual AIAA/USU Conference on Small Satellites  
11 August 2016



**SAINT LOUIS UNIVERSITY**

**PARKS COLLEGE OF ENGINEERING,  
AVIATION AND TECHNOLOGY**