

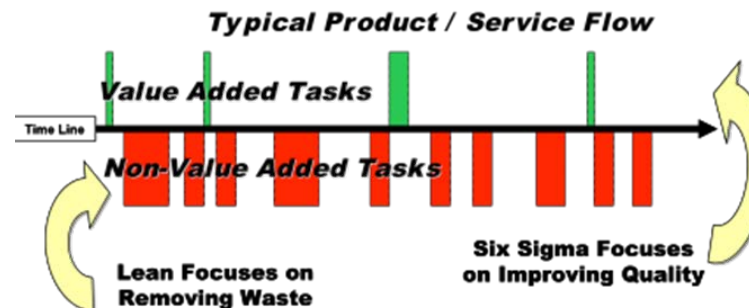
United Nations/Brazil Symposium on Basic Space Technology
"Creating Novel Opportunities with Small Satellite Space Missions"
Natal, Brazil, 11 - 14 September 2018

"Lean Small Satellite Missions Require Lean Access to
Space"

Joseph Casas
NASA Marshall Space Flight Center
Joseph.casas@nasa.gov

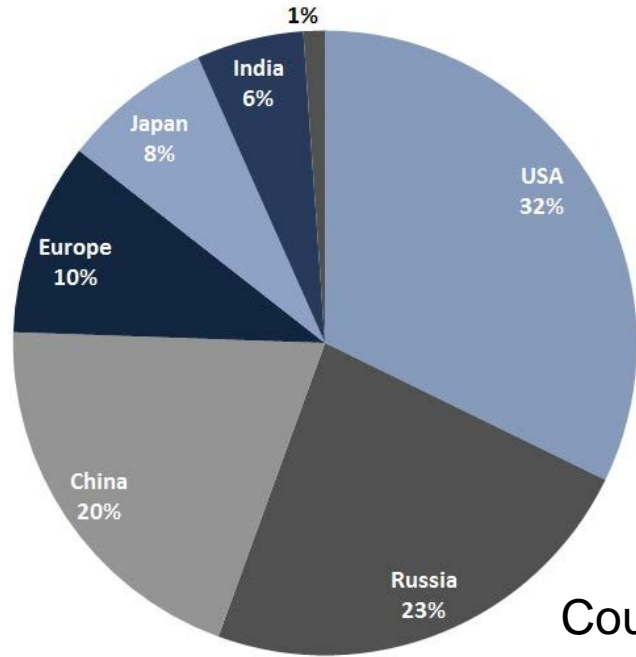
"Lean" Small Satellite Missions Concept

- The concept of “lean satellite missions” was born from the creation and evolution of the practices of lean manufacturing, lean engineering, lean satellites , lean launch and lean operations
- “Lean” is a both technical and management approaches to the “risk and reward” considerations, it is not a standard by itself
- Lean and Six Sigma are widely used in industry as continuous improvement best practices
 - They can also be very **complementary** in nature and, if performed properly, can produce unprecedented results
 - Lean focuses on eliminating non-value added activities in a process and Six Sigma focuses on reducing variation from the remaining value-added steps
 - Lean provides speed ensuring products and services flow without interruption while Six Sigma ensures that critical product / service characteristics are completed correctly the very first time we do them.



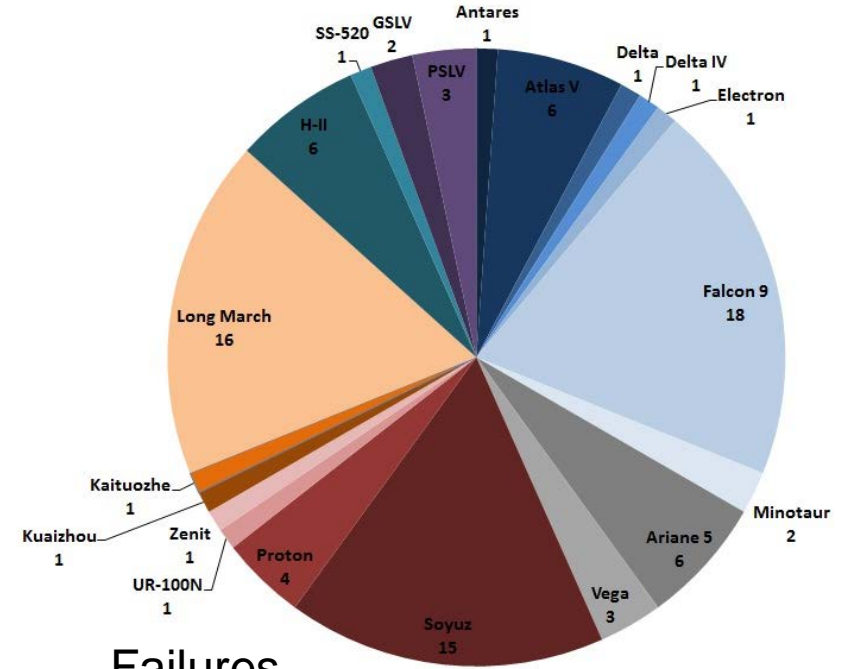
Status of Access to Space

Orbital Launch Attempts by Country



Country	Launches	Failures
USA	29	0
Russia	21	1
China	18	2
Europe	9	0
Japan	7	1
India	5	1
New Zealand	1*	1
Total	90	6

Launch Attempts by Launcher Family




Lean Access to Space

- Improved CubeSat manifesting via NASA's CubeSat Launch Initiative (CSLI)
- As reliability is demonstrated, some providers may be appropriate for future less risk-tolerant NASA missions
- Milestones-based payment structure; **limited** LSP insight through milestone reviews
- A **single demonstration** flight was awarded to Firefly, Rocket Lab, and Virgin Galactic
- Statement of Work: Minimum 60kg to LEO (425km), orbit inclination 33 to 98 degrees, launch date no later than April 15, 2018
- Companies are responsible for LV development costs



Comparison Only

For Comparison Only



Pegasus XL (Orbital)
16.9 m
Up to 443 kg to LEO
1.18 m
Multiple
Certified; Low risk-tolerant spacecraft

VECTOR (new)



Specification *	Alpha 1.0 (Firefly)	Electron (Rocket Lab)	LauncherOne (Virgin Galactic)
Length	23 m	17 m	20 m
Payload Mass	200 kg	150 kg	300 kg
Payload Diameter	1.45 m	1.1 m	1.3 m
Orbit	500 km (Sun Synchronous)	500 km (Sun Synchronous)	500 km (Sun Synchronous)
LV Certification	No certification High risk-tolerant spacecraft		

* LSP recommends a 25% reduction from published specifications for vehicles of this size and maturity until successfully demonstrated

SPORT Space Weather Operational U Class Observatory Constellation

