National Aeronautics and Space Administration

LSP

LAUNCH SERVICES PROGRAM

EARTH'S BRIDGE TO SPACE

Joe Dant
LSP Chief S&MA Officer

Internal procedures/processes for evaluation of flight safety and mission issues

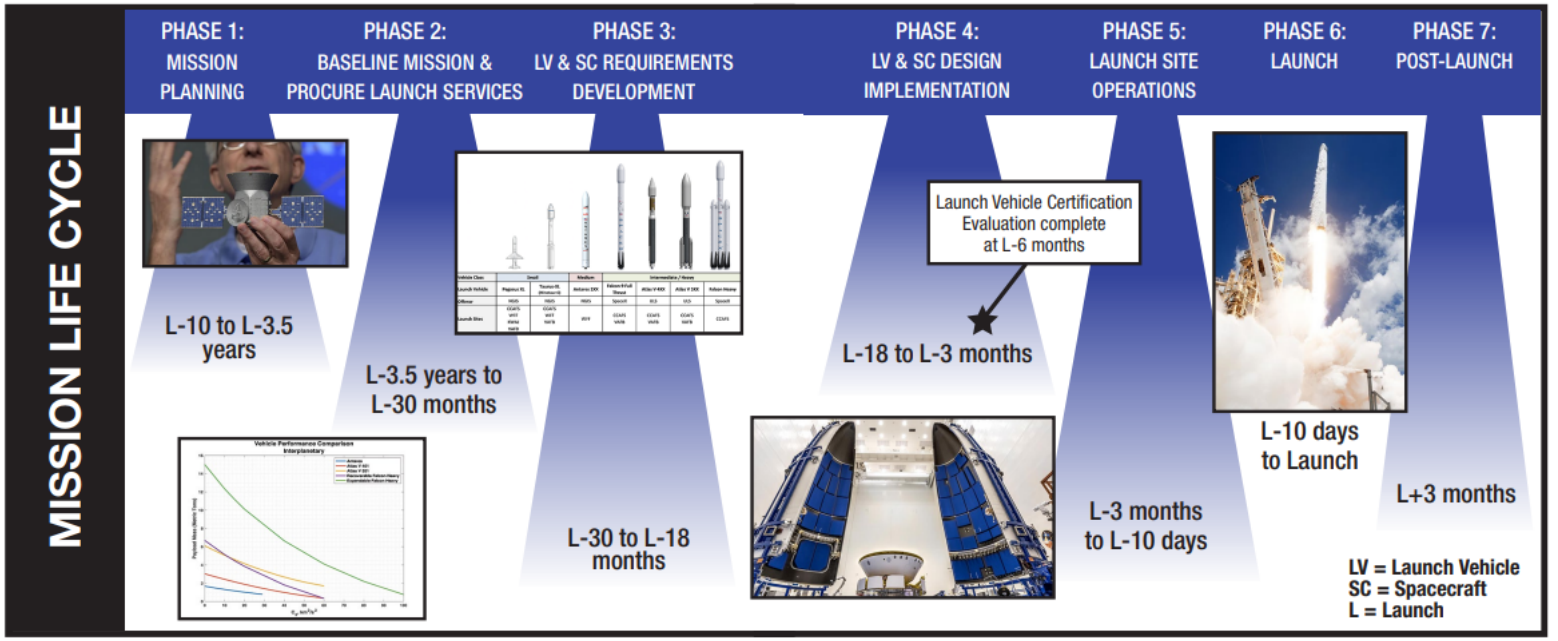
- Context:
  - When procuring commercial launch services, NASA does not buy a rocket, we buy a launch service.
    - » Commercial launch provider provides the rocket and NASA typically provides the “payload” for the launch service which includes crew, cargo, or spacecraft(s)
    - » Several NASA Programs that use various contracts to purchase launch services from commercial providers with varying degrees of “commercial” launch.
- NASA’s Launch Service Program (LSP):
  - Acquires commercial launch services and performs government oversight to increase the likelihood of mission success.
    - » Oversight = Broad Insight + Focused Approvals (Defined in NPD 8610.23)
    - » Significantly leveraging existing US DoD Ranges and their range safety process and requirements
  - Certifies new launch vehicles as risk mitigation for LSP assigned missions
    - » Risk-based certification (Category 1 – 3; High-risk to Low-risk Launch Services) per NPD 8610.7
  - Performs fleet insight and mission assurance for each assigned mission

Fleet Insight and Mission Assurance

- NLS-II contract has fleet insight requirements.
  - Allows LSP and support organizations to have access to flight data, nonconformances, failure/anomaly reports, quality audit participation/results, and production information for the entire fleet, not just assigned mission hardware.
- LSP Mission Managers run the Mission Integration Team that manages & verifies the requirements of each mission
- LSP owns the Engineering Review Process, which is chaired by the LSP Chief Engineer
- LSP S&MA owns and implements the LSP SMA Flight Readiness Process which is chaired by the LSP Chief S&MA Officer

All culminating in the Program, Engineering, and S&MA providing a "ready to proceed" at Readiness Reviews and a "go for launch" during countdown

NASA LSP Mission Life Cycle



PHASE 1
Support the SC mission design with launch service information. Refine SC customer requirements.

PHASE 2
Establish/initiate a launch service contract. Identify all funding and resources required.

PHASE 3
Develop launch services requirements and preliminary design. Support SC build and integration.

PHASE 4
Implement launch services requirements. Support SC build, integration, and test phase.

PHASE 5
Final test and check out of LV and SC systems.

PHASE 6
Integrate SC to LV and test. Launch to place SC in proper orbit.

PHASE 7
Mission Success! Verify LV performance and identify issues to be resolved.

Coverage of High-Powered Rockets

- The failure rate for new launch vehicles is high.
  - NASA's risk mitigation policy documented in NPD 8610.7 mitigates the risk to NASA's robotic spacecraft missions by requiring NASA certification of launch services using a graded approach (high, medium, and low risk certification).
  - Foundation of the policy is based on successful prior flights of launch vehicles
    - ~80% of all launch vehicle failures occur in the first 6 flights (based on research of US launch orbital class launch vehicles introduced since 1990)
- Primary Safety and Mission Assurance requirements are:
  - AS9100 Certification; "applicable range safety requirements"; significant SMA insight; approval of provider Safety, Quality, and Reliability Plans; Delivery of Range Safety Compliance products; access to Quality and Supplier Audits; approval of integrated procedures
- Determining what you want insight vs. approval over is important for policy, contracts, and internal process.
  - NASA LSP uses NPD 8610.23 to define what we want to maintain insight and approval into.

ADDITIONAL INFORMATION

Commercial Launch Service Acquisition

- Primarily through 2 main fixed-price contracts
  - NLS-II
    - » Any US company with a launch service that can put a minimum of 250 kg into LEO that is AS9100 certified can be on-ramped to the NLS-II contract
    - » Requires a successful flight to bid on a mission
    - » Typically for Low and Medium Risk tolerant missions (Class A-C and some Class D missions)
    - » Levies full suite of LSP safety and mission assurance oversight and requirements
    - » LSP retains control of the launch with milestone approvals and ultimate "Go/No Go" on day of launch
  - VADR
    - » Any US company with a developing or viable launch service* with an orbital capability can be on-ramped to the VADR contract
    - » Unless specified in the Task Order, does not require a successful flight to bid on a mission
    - » Only for Class D or higher risk tolerant missions flying on FAA licensed launches
    - » Levies a much smaller set of LSP safety and mission assurance oversight with very limited approvals
    - » No LSP "Go/No Go" on day of launch, only a "Spacecraft Ready" from the customer

*criteria outlined in the VADR contract

LSP Launch Vehicle Certification

- LSP Certification is a non-recurring assessment of a launch vehicle that seeks to understand and mitigate risk for NASA's uncrewed orbital space launch missions. It uses a tiered risk approach to match the launch vehicle to the risk classification of the payload(s) and is governed by NPD 8610.7
- Category 1-3 Certification = High, Medium, Low Risk
  - Different alternatives to get Cat 1-3 certified based on # of successful flights a CLVC has

Launch Vehicle Risk Category	Category 1 (High Risk)		Category 2 (Medium Risk)			Category 3 (Low Risk)		
Payload Class (per NPR 8705.4)	D		C & D, sometimes B			A, B, C, & D		
	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 3	Alternative 1	Alternative 2	Alternative 3
Flight Experience	1 successful flight of a CLVC	No previous flights required, can use the first flight of a CLVC	6 consecutive successful flights of a CLVC	3 (minimum 2 consecutive) successful flights of a CLVC	1 successful flight of a CLVC	14 consecutive successful flights of a CLVC	6 successful flights (minimum 3 consecutive) of a CLVC	3 (minimum 2 consecutive) successful flights of a CLVC

Key Takeaways

- Your Contract, Command Media, and Process should all match
- If using a “commercial launch” approach, don’t over-prescribe requirements
  - Prescribe “what you want” not “how you want it done”
  - Specificity for safety requirements is important; recommend examining the applicable range safety and regulatory requirements and only levying above and beyond those when necessary.
    - » Additional specificity may also be warranted with operations involving government hardware (e.g. a government-owned spacecraft) or within a government facility.
- Balance the need to stimulate and encourage the commercial launch market with the resources you have available.
  - A lot of companies out there with non-viable launch services – recommend finding a way to screen those out and focus resources on the most viable.

FUNCTIONS WITHIN NASA LSP SMA*

Safety

- Provides safety insight and independent assessment to spacecraft and launch vehicle safety analyses
- Reviews/approves spacecraft and launch vehicle operations at the launch site in concert with Range and Provider Safety
- Launch campaign support
- Reliability engineering
- Reviews and integrates mishap contingency planning

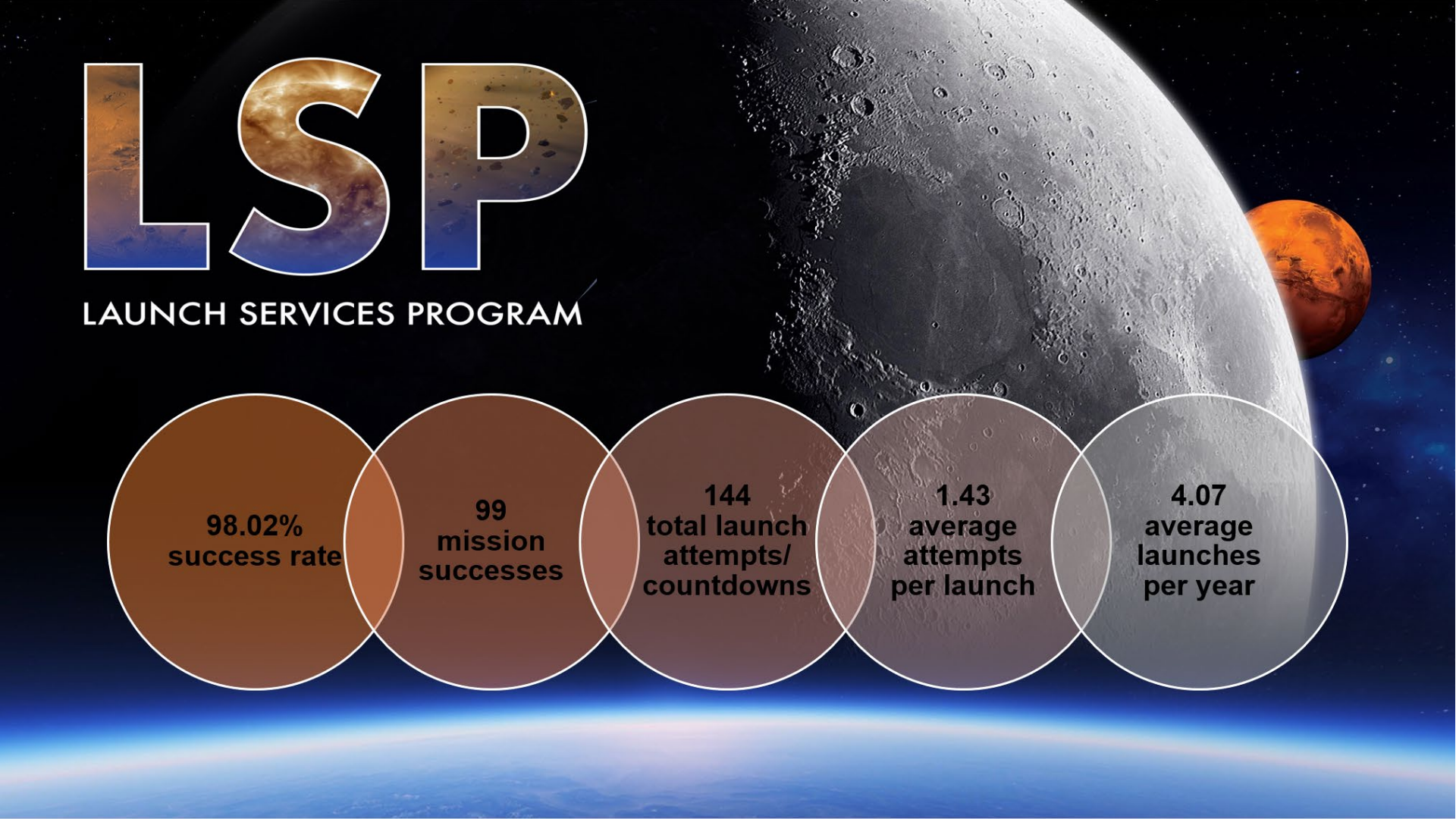
Quality

- Provides quality insight and independent assessment into Launch Vehicle Providers (LVP):
  - Supplier management
  - Production/manufacturing
  - Qualification/testing
  - Launch vehicle integration
  - Spacecraft integration to launch vehicle
  - Launch campaign support
  - Post launch activities

Mission Assurance

- Provides technical review, analysis, insight, and risk-based assessments into:
  - Design Changes/First Flight Items
  - Anomalies
  - Post-flight analysis
  - Launch campaign support
- Coordinates and integrates all mission assurance activities including safety, reliability, and quality related products

*S&MA is only a small portion of the overall NASA LSP role for its missions. LSP has mission management, mission analysis, contracts, business, and engineering personnel that support every LSP manifested mission.


LSP
LAUNCH SERVICES PROGRAM
98.02%
success rate
99
mission
successes
144
total launch
attempts/
countdowns
1.43
average
attempts
per launch
4.07
average
launches
per year