ISS R&D Conference 2019
Materials Science in Space Workshop

Lunar Infrastructure and Surface Operations

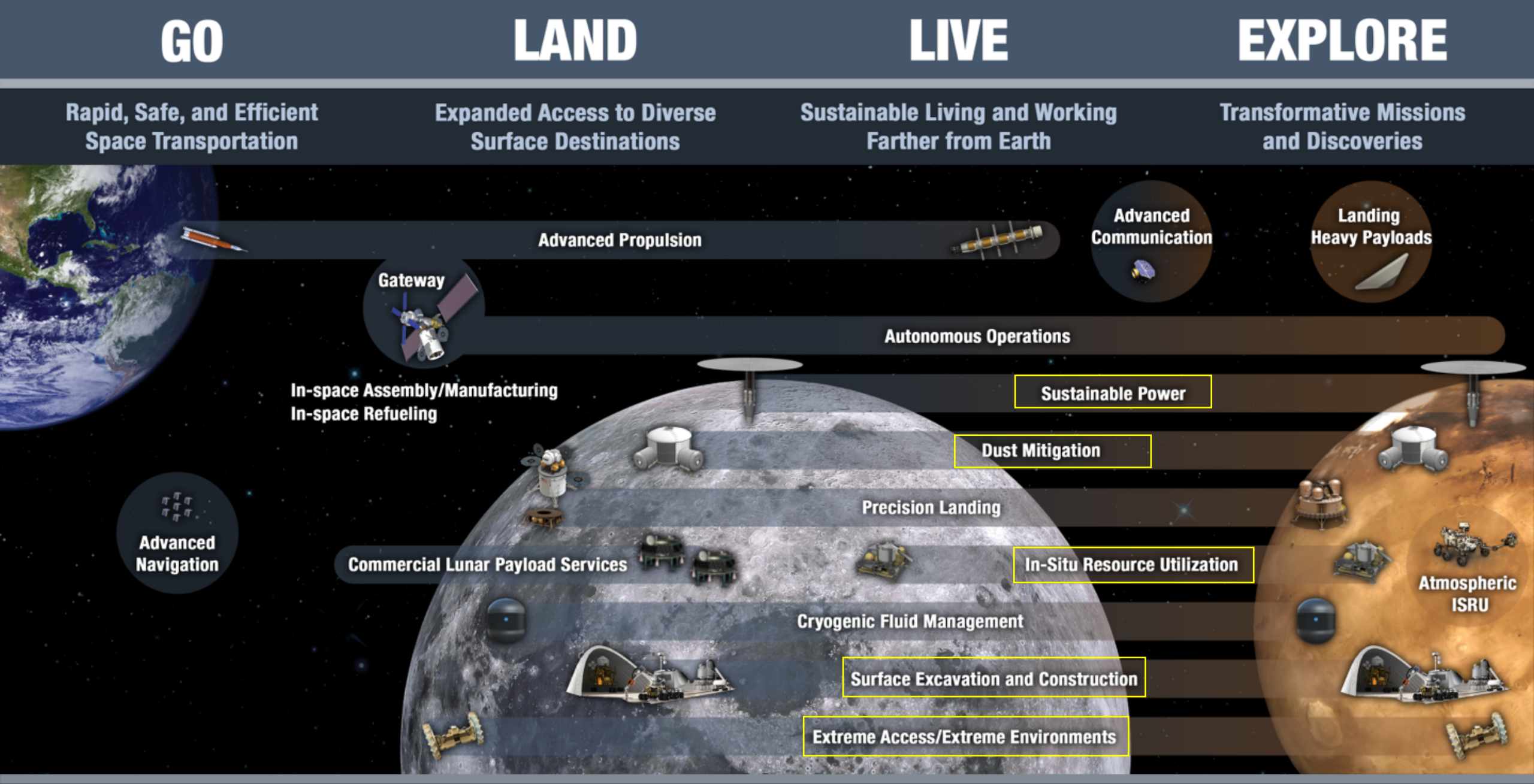
John Vickers, Principal Technologist | 07.29.19

STMD Lunar Surface Innovation Initiative (LSII)

The STMD Lunar Surface Innovation Initiative (LSII) aims to spur the creation of novel technologies needed for lunar surface exploration and accelerate the technology readiness of key systems and components. The LSII activities will be implemented through a combination of unique in-house activities, competitive programs, and public-private partnerships.

LSII Roles and Responsibilities Include:

- Ensuring that there is an ambitious, cohesive, executable Agency strategy for development and deployment of the technologies required for successful lunar surface exploration.
- Integrating a broad spectrum of stakeholders to develop an acquisition strategy which efficiently facilitates robust collaborations and partnerships with industry and academia.
- Addressing planning, implementation, and budget needs to enable lunar surface activities across STMD Programs.
- Collaborating with Agency stakeholders, as well as Other Government Agencies (OGAs), universities, industry, and international partners in order to better align the Agency's investments relative to lunar surface demonstrations.



Lunar Surface Innovation Initiative (LSII)

ISRU Development and Demonstration Timeline

Reconnaissance, Prospecting, Sampling

Sub-system Demonstrations: Investigate, sample, and analyze the environment for mining and utilization.

CLPS Drill Down Select

High-fidelity Simulant Production

Resource Acquisition & Processing

Follow The Natural Resources: Demonstrations of systems for extraction and processing of raw materials for future mission consumables production and storage.

Oxygen from Lunar Simulant Ground Demos

Polar Ice-to-Water Extraction (CLPS)

Lunar Ice to Water Demos

Sustainable Consumable Production

Mars-Forward: Demonstrated, end-to-end systems for extraction, processing, production, and distribution of consumables to support sustained human presence.

Full-scale, Sustainable ISRU Systems for Consumable Production

2019 ***2022*** ***2024*** ***2028***

3D-Printed Habitat Challenge

a NASA Centennial Challenge Program Competition

3DPH Challenge Phase 1: Design

7/2015- 9/2015

Prize Purse: $50,000/$40,000 awarded

(165 entries received, 30 teams were judged)

Develop state-of-the-art architectural concepts that take advantage of the unique capabilities offered by 3D printing.

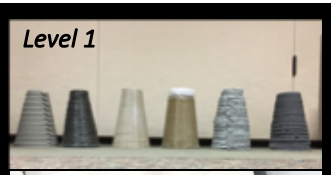
3DPH Challenge Phase 2: Material

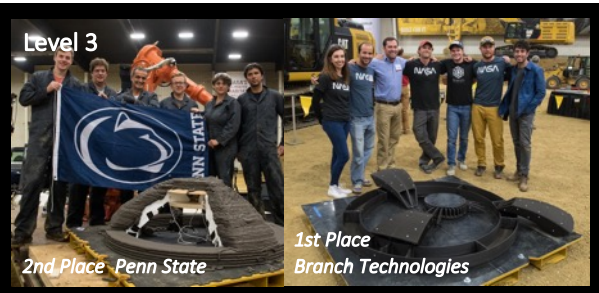
6/2016- 5/2017

Prize Purse: $1,100,000/$701,000 awarded

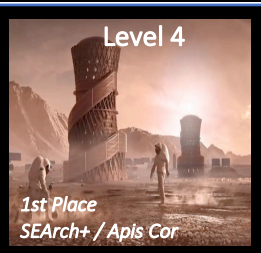
(18 teams registered; 8 teams participated)

Autonomously 3D Print structural components using terrestrial/space based materials and recyclables.





Level 5: Physical Construction Demonstration



3DPH Challenge Phase 3: Build it

11/2017- 5/2019

Prize Purse: $2,000,000/$1,320,000 awarded

(19 teams participated)

Level 4: Virtual Construction (Building Information Model/BIM)

Level 5: Demonstrate an autonomous additive manufacturing system to create a habitat.

Technology Highlights

- Demonstration of safe and innovative new **material** compositions for 3D printing pressure vessels on a large scale with application to NASA missions and Earth construction.
- Demonstration of **processes and equipment** for large-scale vertical autonomous construction.
- Diversity/innovation in viable **designs** of realistic planetary Habitats.
- Innovative use of modeling software common to the construction industry as a more **comprehensive design tool** than the software commonly used by the aerospace industry for Additive Manufacturing technologies.
- Demonstration of new **software and control algorithms** for depositing material in a non-two dimensional layer.

Media Engagement:

- Phase 3 generated **408** media features resulting in an estimated **113.5 million** viewers.
- The Facebook Live broadcast of the head to head competition had **1,936 views.**
- Media coverage included **CNN, Business Insider, Fox News, and Popular Mechanics.**

Acknowledgements

Contributors

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- Robert Moses: NASA LARC In Situ Construction Integrated Steering Group Lead