Space Copy: Exploring Pioneering Technologies For ISRU and Lunar Enabled Manufacturing

Space Copy®

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ABOUT:

- Founder & CEO of Space Copy
- Co-Founder and CFO of Moon Trades
- NASA NRESS Executive Panelist
- UN COPUOS Subcommittee Advisor
- G100 Region Chair of Space Technology & Aviation for the Province of Alberta
- National Small Business Association Rep
- Background in Commerce and Entrepreneurship

INTRODUCTION TO LUNAR MANUFACTURING

Usability of Space Resources, ISRU, and Roles of Additive Manufacturing for Lunar Infrastructure and Colonization Efforts

Value Of Space Resources:

- Supply Chain Management and Infrastructure Development.
- Extractable Resources for Manufacturing and Life Support Systems.
- Lunar Applications for In-Situ Construction, Mining, Agriculture, Clean Energy.

Compositional Structure:

- Oxygen, SiO_2 and AlO_2 Rich Regolith with Trace Amounts of Helium-3, Iron, and Volatile Organic Compounds.
- Regolith is Able to Maintain a Vermicular Shape with Customizable Particle Size Distribution.
- Varied Composition According to Geography: Highlands and Mare.

Additive Manufacturing Capabilities:

- Over 35 Years of Industry Research, Spanning 12+ Printing Methods for Applications in Space, Defense, Extreme Environments.
- Production of Precision Tools, Repair Parts, Interlocking Bricks for Habitats and Roadways Using ISRU.
- Challenges: Reduced Gravity, Temperature Gradient Extremes, Radiation Exposure, Dust Mitigation.

LUNAR ECONOMY AS AN EARLY MARKET OPPORTUNITY

Defining The Space Economy:

- The space economy has a current value of $464B USD. This is slated to increase to $737B USD by 2031, and $1.8T USD by 2040.

- The lunar manufacturing market is currently valued at $1.5B USD. This is slated to increase to $7.5B USD per year by 2030.

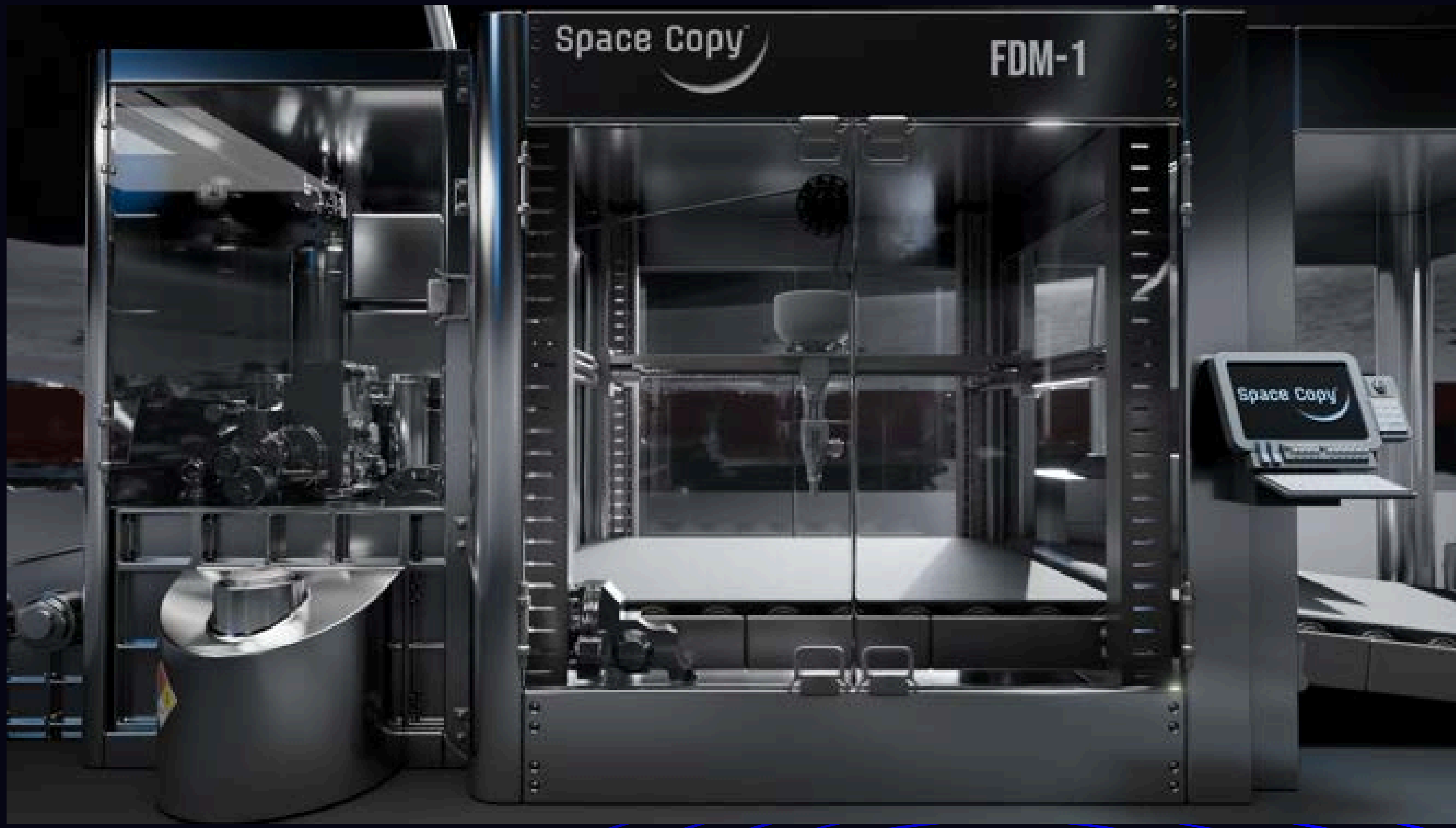
- The lunar economy is recognized globally as the most fast-paced growth induced economic market since the dot com bubble.

- The next generation of spaceflight will involve colonizing the Moon and Mars, a challenge which can only be safely conducted if lunar manufacturing is widely developed and utilized. This notion is recognized by global industry leaders in space, government, academia, and industry.

ABOUT SPACE COPY

The Project:

A multi-purpose 3D printer combining regolith sampling, spectral data analysis, AI/ML, and additive manufacturing into one mechanism, improving infrastructure development for extreme environments on Earth and in-space.



Goals:

- Advance ISAM Research and Development.
- Prioritize the Expansion of Scalable Infrastructure for Earth, Moon, and Mars.
- Accelerate Ongoing Efforts for the Emerging Commercial Space Industry.

LUNAR ADDITIVE MANUFACTURING AT A GLANCE

Space Copy is developing multi-purpose 3D printers combining regolith sampling, spectral data analysis, AI/ML, and additive manufacturing into one mechanism, improving infrastructure development for extreme environments on Earth and in-space.

Selective Laser Melting In Vacuum Conditions:
SLM works to melt regolith into precise geometries; to avoid Earth-dependency, vacuum conditions are employed to offset external conditions and improve process parameters.

Beneficiation To Achieve Durable Feedstock
Pre-processing, robotics, and continuous analysis aims to optimize morphology for compatibility.

Material Characterization With Raman Spectroscopy
Works to determine mineralogy and compositional structure of lunar materials.

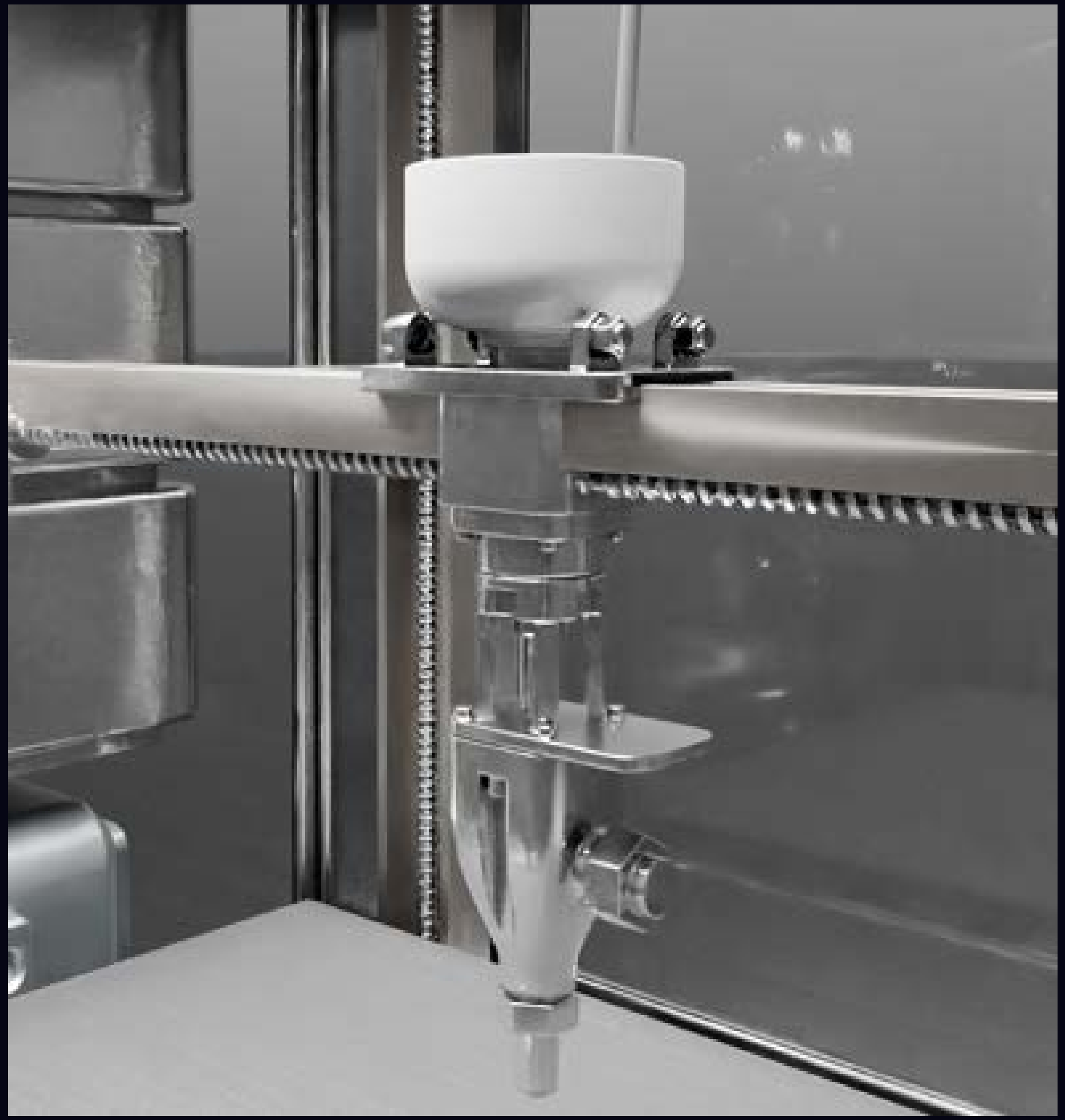
PROGRESS: TRL 3/4 | PATENT PENDING | INTERNATIONAL PARTNERS

REGOLITH AS A STRUCTURAL MATERIAL

- The varying particle size distribution and vermicular particle shape characteristic to lunar highlands regolith enables the need for consistent interaction of rotation, translation, and inversion during the pre-processing stage to create a feedstock that is viable for additive manufacturing of precise geometries.

- The beneficiation of cobbles and loose soil would undergo a three-dimensional motion, inducing a constantly changing and rhythmically pulsating state in the mixed material. This process swiftly yields high-quality mixing results that meet the most stringent requirements, coupled with speed to offset gravitational distortion in reduced gravity environments.

- The pre-processing equipment adopted by Space Copy would be utilized for producing homogeneous mixtures of powdery components with differing specific weights and particle sizes, and would occur within a completely enclosed vessel, ensuring contamination-free results.



PURPOSE FOR CLOSED VACUUM MANUFACTURING IN SPACE

1. Closed Environment: In a closed vacuum system, the entire LPBF process occurs within a sealed chamber to maintain low-pressure conditions and prevent external contamination.

2. Oxide Collection: As the regolith is melted by the laser, oxides present in the material are vaporized and released into the chamber.

3. Condensation: Inside the vacuum chamber, the released oxides are allowed to cool and condense onto specially designed surfaces or capture materials.

4. Collection Mechanisms: Various collection mechanisms, such as condenser plates or traps, are strategically placed within the chamber to capture and accumulate the condensed oxide particles.

SPACE COPY’S VISION

“ADDITIVE MANUFACTURING ALLOWS FOR SUSTAINABLE USE OF LOCAL RESOURCES FOR RAPID PROTOTYPING IN EXTREME ENVIRONMENTS”

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In-Space Manufacturing Milestones

TERRESTRIAL USE

Military, defense, and construction applications for natural disasters and remote areas

2025

AUTONOMOUS LAUNCH

AI powered operations controlled by Deep Neural Networks

2027

INFRASTRUCTURE AND PRECISION FABRICATION

Bricks, launchpads, roadways, piping, repair parts, and precision tools

2028

CREWED USE

In-situ operations for en-masse construction led by astronauts for large-scale colonization

2030

MOON TO MARS

Presentations are communication tools that can be used as lectures.

2035+

Challenges, Process, and Applications

- Environmental conditions in space: radiation exposure, temperature extremes, dust mitigation, reduced gravity.

- Environmental conditions on Earth: temperature extremes, weather, unpredictable climates.

Applications:

- Infrastructure Development
- Natural Disaster Response
- Lunar Colonization
- In-Space Refining and Manufacturing

TRENDS, DATA, AND SUPPORTING RESEARCH

• It currently costs an average $1.2M per kg to send a resupply payload to the lunar surface.

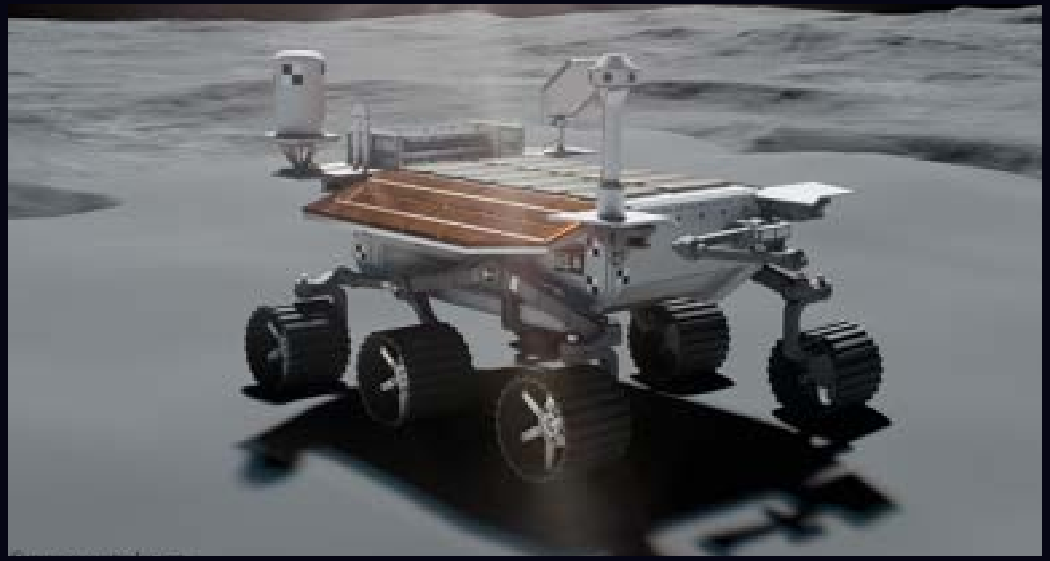
• Additive manufacturing can reduce up to 70% of required materials needed to sustain a lunar colony.

• Citing an estimated $3.5B in immediate cost savings per astronaut during the first operational year of lunar manufacturing.

FUTURE INITIATIVES

Additive manufacturing can be combined with ISRU for the responsible development of sustainable off-planet construction.

This will enable a closed-loop economy for In-Situ Resource Utilization (ISRU).



RESOURCE EXTRACTION
& BENEFICIATION

ISRU MANUFACTURING

LUNAR INFRASTRUCTURE
DEVELOPMENT

THANK YOU

LEARN MORE

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LOCATIONS

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