LSIC Lunar Proving Grounds Workshop: Efforts Toward Unifying Lunar Technology Testing Facilities.

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Introduction: The Lunar Surface Innovation Consortium (LSIC), established by NASA's Space Technology Mission Directorate and managed by the Johns Hopkins Applied Physics Laboratory, is hosting a Lunar Proving Grounds Workshop in July 2023 to identify the needs of the community for testing their technologies in relevant environments to prepare them for the lunar surface. While there currently exists several testing facilities to raise the TRL of technology components, there is currently an unmet need to understand how to verify and test the interoperability and integrated operation of the components and individual systems. The objective of this workshop will be to, first and foremost, identify the community's needs, as well as understand the characteristics of a potential Lunar Proving Ground needed to ensure the success of these technologies on the lunar surface.

Background to LSIC: The primary goal of the Lunar Surface Innovation Consortium is to bring together universities, non-profit institutions, commercial companies, NASA, and other government agencies to identify the technical capabilities and challenges involved in establishing a sustained presence on the Moon. LSIC serves as a central hub of information to provide efficient communication of NASA's technological needs to the community as well as provide timely input to NASA on what technologies are available for deployment. LSIC is also intended to enable team building, pulling from a diverse community that encourages networking, partnering, and collaborations to amplify the results of individual efforts in technology development for lunar exploration.

LSIC seeks to not only foster technology development to support the Artemis program, but also to help stimulate and support commercial companies that would like to participate in the future lunar economy. LSIC hosts meetings and workshops throughout the year, feeding forward findings from these to guide the topics for future discussions, develop community resources, and to provide feedback to NASA on community needs. Previous workshops have included focusing explicitly on the supply and demand aspects of areas such as in-situ resource utilization and excavation and construction, low temperature power supply and distribution, designing for the extremes, and mapping for precision landing. This workshop is intentionally being developed as a cross-focus group effort with system integration as a priority.

Motivation for a Lunar Proving Grounds Workshop: The topic of test facilities and a Lunar Proving Ground has come up across all six Focus Areas of LSIC: Dust Mitigation, Excavation & Construction, Extreme Access, Extreme Environments, In-Situ Resource Utilization, and Surface Power. Facilities do currently exist (operated by NASA as well as various universities and companies) that can provide testing abilities for technologies in a simulated lunar environment -- however, these are usually aimed at component- and instrument- level testing. Those testing needs can vary drastically depending on the technology and its intended use, and it is not currently clear whether the community has access to what it would need in order to successfully and holistically test technology in preparation for the lunar surface. Furthermore, technology developers will need access to a single location, and/or a network of locations, where they can verify and validate their technologies while operating with other dependent technologies at the larger system-level to ensure system readiness for flight and operation on the lunar surface. An integrated testing facility(ies), or Lunar Proving Ground(s), can help ensure the success of these technologies, and requirements for this Lunar Proving Ground must be defined.

LSIC Lunar Proving Grounds Workshop (July 2023): LSIC is planning this Lunar Proving Grounds Workshop for mid-July, 2023, as a two-day, hybrid meeting. This workshop, to be kicked off with a few notable keynote presentations/lectures, will consist of several panel discussions on the first day motivated by questions and comments from the audience, accompanied by open discussions throughout both days that serve a "roundtable"-style purpose to encourage input and participation from all workshop attendees.

Questions that this Lunar Proving Grounds Workshop will address include:

1. What testing, demonstration, verification, and validation capabilities are specifically needed by technology developers, e.g., what are the requirements for a Lunar Proving Ground?
    a. What are the goals of a Lunar Proving Ground?
    b. What are the requirements of a Lunar Proving Ground?

   c. What approaches can be affective at meeting these requirements?
   d. How will the capabilities and other attributes of a Lunar Proving Ground need to differ from the testing facilities currently available?
2. Given those requirements, what are the characteristics that technology developers desire in a Lunar Proving Ground?
   a. Who should organize and run the Lunar Proving Ground; government, a university, a consortium?
   b. Will the Lunar Proving Ground be a network or a single location?
3. How can we better connect users with providers?
4. Based on these conversations, what do we need facility owners to know?

This Lunar Proving Grounds Workshop will help elucidate facility needs and highlight testing environments that are needed. Most importantly, the workshop will identify how a Lunar Proving Ground will need to operate and what it must consist of in order to ensure the success of technology developers.

The objectives of this workshop are specifically to:

1. Define a Lunar Proving Ground, from the perspective of the technology developers.
2. Collect (not set) requirements from technology developer's perspective for a Lunar Proving Ground.
3. Link community users with providers: identify the value chain, such as how to get access to facilities, etc.
4. Understand facility owners' capabilities and capacities, including the bottleneck of testing.

Workshop Results and Outputs: The goal of this discussion will be to disseminate information regarding the upcoming LSIC Lunar Proving Grounds Workshop, as well as converse with the space resources community on the goals and outcomes of the Workshop and what must be accomplished through this Workshop. Through addressing the above four objectives, we intend to accumulate a detailed set of community needs and requirements for a Lunar Proving Ground, determine where gaps currently exist in identifying and/or initiating a Lunar Proving Ground, and understand how to ensure that technology developers do not experience a barrier-to-entry for testing in this Lunar Proving Ground. With these findings, we intend to produce a set of recommendations that describe the characteristics of a Lunar Proving Ground to help ensure the success of technologies that will operate on the lunar surface. By participating in an open-forum discussion prior to the Workshop itself taking place, we intend to assess the state of the community and their desires for what this Workshop must contain and not contain, and what accomplishments and/or deliverables would be the most beneficial to technology developers by the end of the Workshop.