

# Report from Extreme Access Monthly Meeting

June 2020

## Notes From Discussion

*Longform discussion notes available on page 3*

- Need for both hardware and software development
- Technology needed for both robotic and human exploration support
- Will need onboard autonomous decision-making capabilities b/c communications in early stages of Artemis program will be limited
  - Need to not just collect data, but make autonomous decisions based on data collected
- Science and technology needs will be parallel to each other
- Data collected will need to be “assay grade”, up to terrestrial mining standards - “ground truth”
  - see JORC reference in notes from chat
- USGS is getting interested in lunar resources as well
- Will NASA calls be open to all groups?
  - There will be funding calls to develop technology, though can’t speak to specifically who those will be targeted to, but LSIC will work to get information on those opportunities for members as they arise
- LSIC is combining civilian, government, and commercial actors to pursue lunar equity in all spheres
- Diversity and inclusion are explicit goals of LSIC
- International participants are welcome at LSIC meetings but funding opportunities will likely be directed towards US participants
- A directory of LSIC members is currently in the works

## Notes From Chat

*Full chat discussion transcript available on page 6*

### **Suggested readings:**

- Craig Peterson: <https://solarsystem.nasa.gov/resources/292/extreme-environment-technologies-for-future-space-science-missions-september-2007/>
- Samuel Courville: Than Putzig, Matt Perry, and I have a white paper in progress for developing active source seismology, partly to survey ice in lunar permanently shadowed regions. Here’s the link: [https://docs.google.com/document/d/1HK8jTqb2QiYiD7UUIKkPreDIbvuyT-O8KhJmPn\\_QRJo/edit?usp=sharing](https://docs.google.com/document/d/1HK8jTqb2QiYiD7UUIKkPreDIbvuyT-O8KhJmPn_QRJo/edit?usp=sharing)
- marshall Eubanks: LEAG has a white paper list on line [https://docs.google.com/spreadsheets/d/1iT4Bo\\_NhRGGXuEqnaEYRTBHA3SS6XSalTFPpLSiQSiK/edit#gid=472923996](https://docs.google.com/spreadsheets/d/1iT4Bo_NhRGGXuEqnaEYRTBHA3SS6XSalTFPpLSiQSiK/edit#gid=472923996)
- Don Barker: Suggested reading: <https://www.sciencedirect.com/science/article/pii/S0273117720302234>

### **Communication / Collaboration Model:**

charles radley: On the international stage. the Moon Village Association is quite active, they have a WhatsApp group.

### **Mining Standards**

Elizabeth Frank: Re: the last question - JORC is a commonly used standard in the mining industry for mineral resource reporting

marshall Eubanks: <http://www.jorc.org/>

### **Pending Questions:**

- When will slides be distributed?
- From the in-meeting poll:

- What is the “Other” category?
- Is APL academia?

## Longform Discussion Notes

Deborah: What is the technology development aspect of that?

Angela: If you need to do real time assessment and don't have a person there, it's a software, for some it's software, for some its instrumentation, it can be a mix of the two.

Eldar – I got my connection dropping out – I was supporting you in that we need tech not only for accessing but also for exploring. If you're looking into DSRs, you'll need some sort of augmented forms of illumination, active illumination. Sometimes you might not be able to access PSRs for long, you might need to find ways to explore PSRs remotely. Surface techs are also important here.

Gordon – I would add robotics to that – robotics that can operate in PSRs are different than what's been developed to date.

Deborah – We need to be able to say, 'I want a core over here but not over there'. Assess your location, whatever your criteria for selecting where you want to take a core, need to do that autonomously. That's hardware but also software.

Dana – The technology needed to enable science is the same to develop for lunar surface operations so there's parallels.

Deb – Definitely parallels between science and tech. Whatever you'd do for science you'd need here.

JD – Thinking of the previous conversation, it sounds like data driven robotic sampling but to summarize what was being discussed...

Deb – It includes data driven sampling, but also have to have the ability to autonomously make decisions. It's not just collecting data but also making a decision based on data collected.

JD – Did you say that data driven doesn't capture that implicitly?

Deb – It can be a combination thereof – if it's a difficult to assess area you're likely not sending people in. If your robot doesn't have an ability to communicate quickly with people, it may have to make decisions on its own. Not just data collection but making decisions based on that.

Gordon – The communications at least in the early stages of Artemis program will be limited, s autonomy will be very important.

JD – So onboard autonomy is what you're stressing.

Chuck Lauer – one of the things I'd like to point out is that data has to be assay grade. If there's going to be any commercial case for lunar resources it's gotta be bankable quality, as in up to terrestrial mining standards. There's a minimal level of utility needed if anybody's commercial case is going to close.

Angela – So technology development would be on the instrumentation / data collection side to increase the quality.

Chuck – in general. Fundamental requirement from commercial side data has to be bankable to the same standards that a terrestrial mining co is going to look at a gold deposit. If you're going to invest money you have to have the ground truth. The sound bite I use is assay grade ground truth. From a pure science point you may not need that but on commercial grade

Deb – Not just hardware but software. Everything.

JD – Question – Are there standards already for geospatial units for this kind of data?

Chuck – I don't have them handy, but sure there are. If there's anyone from Colorado School of Mines, bounce off of George Sours. There's probably literally a gold standard that anybody would use. I would talk to CSM or anybody in that genre for providing that data.

Gordon – the US geological survey has that. For any US mining operation, they have to put their stamp of approval on it. Interestingly, USGS is getting interested in lunar resources as well. May have things to say about those standards to be used.

Deb – In technology development will there be calls for financial support from NASA? Will they be open to all groups, not just academia, NASA centers, but across the board?

Angela – do we have any folks from NASA on the line before I give it a go?

Angela – I am not a NASA employee so I want to preface this. I think the intention is that there will be funding calls to develop technology. NASA's goal is to have a staged presence on the moon, to do that they recognize there will need to be technology development. There will be calls in the future targeted at specific types of tech at different TRLs. I have at the end of my slides, a couple of things that are potentially upcoming calls. I can't necessarily speak specifically to who those calls are targeted to as I'm not the funding agency, but part of my job and part of what LSIC will provide to all of you is a place where you can find that information very easily. If there are gaps that feedback can be given back to NASA in the 'this group has tech and maybe they're not being heard' and we can provide that feedback back to NASA.

Charles Finley – I'm actually a NASA guy but couldn't give firm path forward. I worked at the Air Force Research Lab. NASA has equities, scientific exploration, companies have equities ie: commercial potential of a domain. International folks have equities. And the Air Force / Space Force Research Lab has equities. Is this specifically going to focus on scientific exploration, or will we talk about shared equities and how a lunar comm architecture that is potentially secure enough for national security use as well as civil exploration use, or proprietary commercial use, might be a good idea.

Angela – I think it's both. As a civ agency, a large portion of what we focus on will be scientific and human exploration. But this consortium is spec designed to include other gov't stakeholders and industry so those type of conversations can happen.

Charles – I think that's smart. As we potentially approach a post-pandemic recession dealing with an organization funded out of discretionary income, it's good to have national security money in play as it benefits other objectives.

Angela – Where this could help with that is building partnerships / relationships. There are opportunities for lunar exploration and while we are specifically chartered by NASA, people can build teams and groups to focus on anything.

Gordon – At the Kickoff meeting there was significant DOD and commercial presence.

Angela – That's a good point to make. The lunar surface exploration, there are a lot of stakeholders. Keeping that in mind when we have conversations – we can and we will likely have spinoff meetings and spinoff smaller targeted focus group teams, and perhaps one of them could be communications architecture for different specialty technologies and these conversations can be had in more detail.

Deb – Is there a goal to diversify?

Angela – that is specifically one of our goals and also in our code of conduct. Bringing in a diverse set of voices and helping to increase that is definitely a goal for us.

Susan- Is the group only restricted to US or is it international?

Dana – the LSII effort is US, but our meetings are open to all. So for example our kickoff was livestreamed and they are all public. We don't handle ITAR information in these forums, so that concern is not an issue. But in terms of the purpose of it, making connections to work going on around the world, it's great to have participants externally but in terms of informing NASA on funding opportunities and that sort of thing, those are open to US participants.

Chuck – the Artemis accords / NASA's rollout are targeted to have the rest of the world sign up, so I don't see harm in addressing international outreach within this forum.

Joseph Galente- I'm a PI of a robotic mobility system, I work at NASA, trying to get a mobility system, we're interested in great science payloads wherever they come from. We're excited about teaming with non-US organizations to make that happen.

Angela – We're not going to not include international participants in these calls.

Deb – Joseph are you looking for partners right now int'l partners, or not ready yet? Looking to make connections?

Joseph – We're still in early stages.

Deb – if you want some help with international connections just ping me.

Joseph – thank you.

Chuck – Will there be a networking "speed dating" profile database? I already see people on this call I want to have private discussions with, but I don't necessarily have that information. Can that form of discussion be facilitated.

Angela – That's in the works.

Joseph – how did you want to share info?

Angela – Email me, email the listserv. If you don't want to have that you can email them to me and I'll bring them up at the next meeting for discussion or you can just bring them to the next telecon. Any of those options work.

Deb – Artemis is to put people on the moon. Are we looking for technologies that are independent of interaction with people or are we looking only at technology that interacts with people?

Angela – I think it's either or both. Yes, we are wanting to assist in the goals of the Artemis program, but NASA's long-term plan right now is to have a sustained presence which includes robotics and humans. It could be a robotic tech or something that requires human interaction and as a group we just pick which we think might be the most pressing for us to work on.

Craig Peterson – Wanted to mention that while there hasn't been an update in a decade, here was an extreme environments roadmap report available at one time through the solar system exploration website. While it didn't explore lunar needs, a lot is applicable at both high and low temp applications. While it may be a bit long in the tooth, might still be worth taking a look.

## Complete Chat Discussion Record

marshall Eubanks: Is the Far Side an Extreme area

Jnaneshwar Das: mapping?

marshall Eubanks: Can commercial grade be quantified?

Don Barker: Suggested reading: <https://www.sciencedirect.com/science/article/pii/S0273117720302234>

Elizabeth Frank: Re: the last question - JORC is a commonly used standard in the mining industry for mineral resource reporting

Chuck Lauer: Thanks

marshall Eubanks: <http://www.jorc.org/>

marshall Eubanks: What is the work product of this effort? A paper? Refereed? A "living review"?

Rachel Klima (JHUAPL): And we can also carry those concerns about who can propose up to folks at STMD as they craft those calls

Rachel Klima (JHUAPL): (can and will)

Rachel Klima (JHUAPL): Aiming for early September (would be before LEAG)

Chuck Lauer: Space Marines coming soon?

marshall Eubanks: It came up here.

Rachel Klima (JHUAPL): May not be visible if you're through a browser?

Mike Broome: Marine Corps Hymn says "any clime or place" so, technically, we already have Space Marines ;)

Andrea Harman (LSIC Support): Industry: 38% Gov't / NASA 5% Academia 25% 28% Non-profit Other - 5%

Michael J Poston: What is APL? Academia?

Dr Susan Ip-Jewell MD USA: what is Other?

Andrea Harman (LSIC Support): @Susan I believe that's anyone who doesn't fall into one of the listed categories.

Dr Susan Ip-Jewell MD USA: Can you give me examples...I am interested who they are?

Joseph Galante (NASA GSFC): how will a lot of these "value to you" points be mechanized? will there be a forum or message board available?

Rachel Klima (JHUAPL): YES

charles radley: On the international stage. the Moon Village Association is quite active, they have a WhatsApp group.

Rachel Klima (JHUAPL): We are working on having a wiki for communication that won't spam everyone, and if anyone wants they can have the mailing list set to be digest mode (should it become too much traffic)

Rachel Klima (JHUAPL): Also the recording and notes from this meeting will be put on our website for now, until the Wiki is ready

Rachel Klima (JHUAPL): Great idea

marshall Eubanks: LEAG has a white paper list on line

marshall Eubanks:

[https://docs.google.com/spreadsheets/d/1iT4Bo\\_NhRGGXuEqnaEYRTBHA3SS6XSalTFPpISiQSik/edit#gid=472923996](https://docs.google.com/spreadsheets/d/1iT4Bo_NhRGGXuEqnaEYRTBHA3SS6XSalTFPpISiQSik/edit#gid=472923996)

Chuck Lauer: when will these slides be distributed?

Samuel Courville: Than Putzig, Matt Perry, and I have a white paper in progress for developing active source seismology, partly to survey ice in lunar permanently shadowed regions. Here's the link:

[https://docs.google.com/document/d/1HK8jTqb2QiYiD7UUIKkPreDIbvuyT-O8KhJmPn\\_QRJo/edit?usp=sharing](https://docs.google.com/document/d/1HK8jTqb2QiYiD7UUIKkPreDIbvuyT-O8KhJmPn_QRJo/edit?usp=sharing)

Craig Peterson: <https://solarsystem.nasa.gov/resources/292/extreme-environment-technologies-for-future-space-science-missions-september-2007/>