Terrestrial mining applications for lunar regolith excavation robotics. A.M. Neale[1,3] and J. Maré[2,3], [1]Hatch Africa (mneale@hatch.co.za), [2]University of Pretoria (jj.mare@gmail.com), [3]SASRA (www.sasra.co.za)

Introduction: Developing space mining capabilities will have earth benefits[1,2]; technology spin-off being one of them. If such spin-offs and its potential beneficiaries are identified early on, it will be easier to get support for developing the space mining technologies.

This paper looks at lunar excavation robotics as a space mining technology that could have terrestrial spin-off. Possible terrestrial mining applications are identified and ranked to support the identification of potential beneficiaries / investors.

Workshop on applications: A workshop was held with six mining engineers and one mining engineering student (authors included). Background was given on work being done for lunar excavation robotics, and included the examples of: the three musketeers[3], the pneumatic excavator[4], Astrobotics' excavator[5] and the NASA lunabotics competition[6]. For the purpose of the workshop a lunar excavation robot is summarized as:

- Small and lightweight
- Autonomous or tele-operated
- Possibly to swarm
- Reliable

The workshop question was:

"If you had a supply of lunar excavation robots, as per the summary, where would you apply it in the mining industry?"

Results from workshop: The workshop resulted in the following possible applications, each of which is described in the presentation:

1. Mineral sand production
2. Mineral sand top-up
3. Greenfields sampling
4. Crack filling for coal burn dumps
5. Top soil removal
6. Clean up in sensitive areas
7. Scavenging mining losses
8. Scavenging outside mineable limits
9. Pothole mining
10. Narrow stope production
11. Narrow stope vamping
12. Micro mining

Short ranking of options: The workshop was of the opinion that, in order to rank the applications without going into economic detail, it is necessary to look at the scale and flexibility required. Lunar excavation technology would be most competitive in small scale, high flexibility applications.

The 12 options are compared and categorized in Figure 1 acording to scale and flexibility required. Four options fall in the small scale, high flexibility category, and further investigation is recommended for at least these applications.

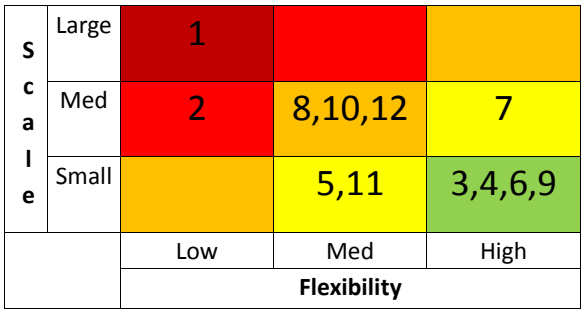

Figure 1: Categorizing of possible terrestrial applications; color scale from maroon to green indicating increased competitiveness of lunar excavation technology

Conclusion: A workshop resulted in 12 possible terrestrial applications for lunar excavation technologies. The applications were categoriszed according to required scale and flexibility. Lunar excavation technology would be more suited to smaller scale, and higher flexibility applications.

The recommended applications for further investigation are: greenfields sampling, crack filling for coal burn dumps, clean up in sensitive areas and pothole mining. Other applications that can be considered for further investigation are: top soil removal, scavenging mining losses, narrow stope vamping.

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