# Terrestrial Mining Applications for Lunar Regolith Excavation Robotics

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# Introduction

Ultimate Goal:

Space Mining

Technology

Motivators:

ISRU

Mineral Value Return

We are here:

Earth

# Introduction

Technology gap

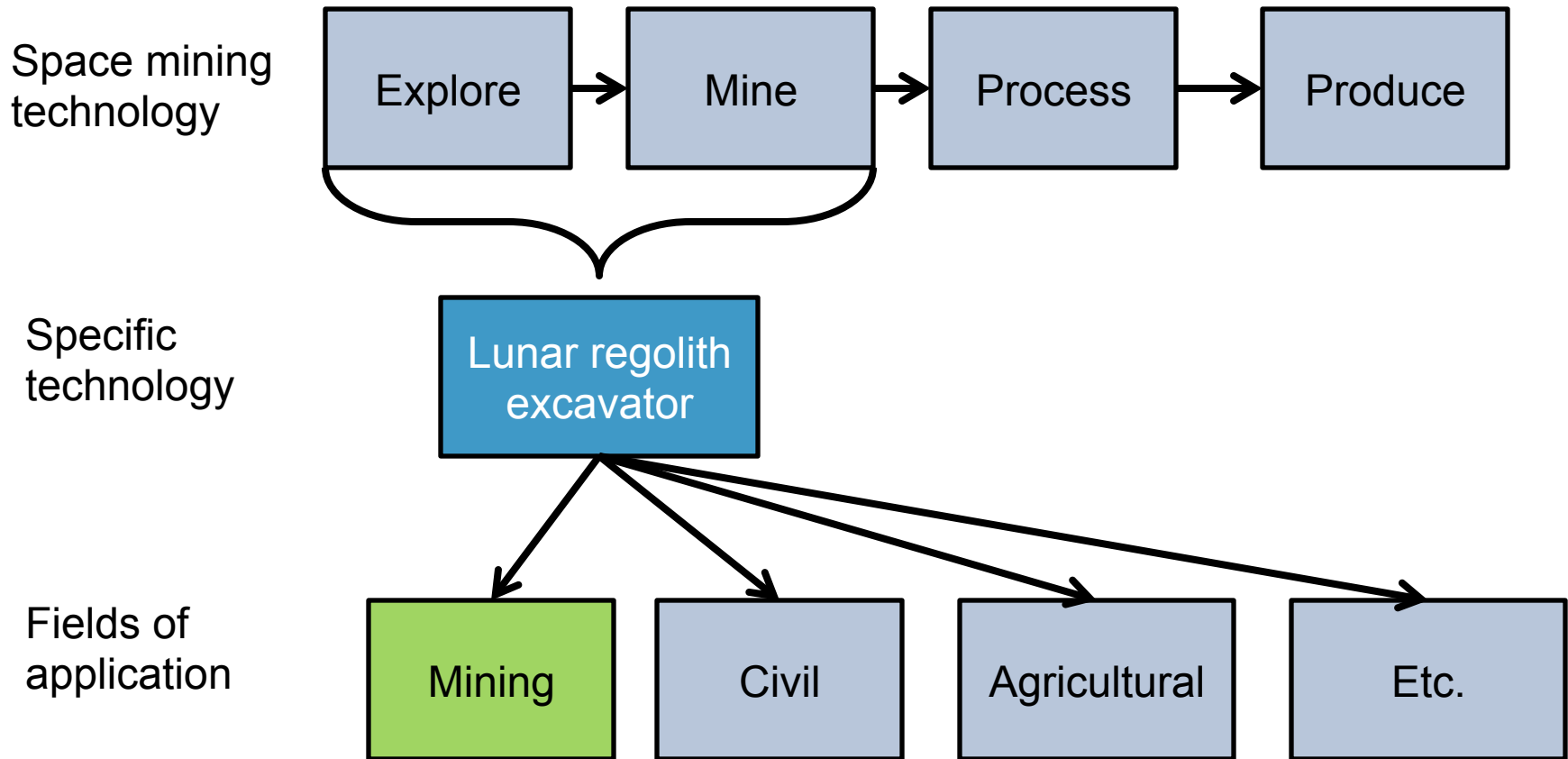| Current technology | Improve #1 | Improve #2 | Improve #n | Target technology |
|---|---|---|---|---|
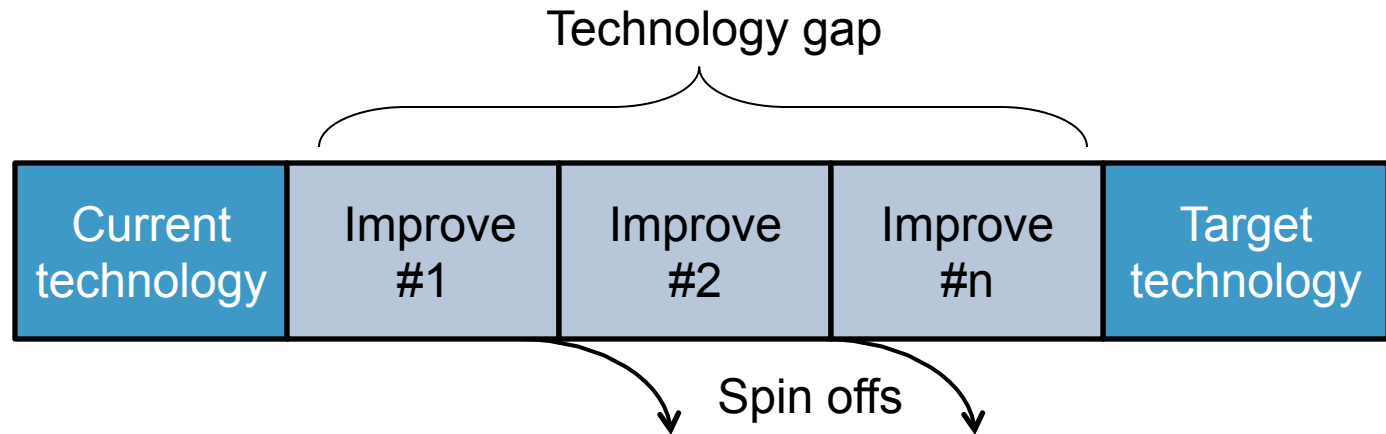
Spin offs

Our plan:
- Identify early spin-offs
- Find an "Earth client" who is interested
- Develop next step for client

# Framework



**Space mining technology:** Explore → Mine → Process → Produce

**Specific technology:** Lunar regolith excavator

**Fields of application:** Mining, Civil, Agricultural, Etc.

# Current technology

# Target technology / spin off

Excavation robot:

- Small / lightweight
- Autonomous / tele-operated
- Possibility to swarm
- Reliable

# Options ranking

| Scale | | Low | Med | High |
|---|---|---|---|---|
| | Large | 1 | | |
| | Med | 2 | 8,10,12 | 7 |
| | Small | | 5,11 | 3,4,6,9 |
| | | Low | Med | High |
| | | **Flexibility** | | |

| | |
|---|---|
| Discard | (dark red) |
| Discard | (red) |
| Tertiary | (orange) |
| Secondary | (yellow) |
| Winning | (green) |

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

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# Discarded options

- Sand mining production ≈ 1500-4500tph



- 'Lunar' Excavators required ≈ 1500-4500

# Discarded options

- Sand mining top up > 300tph



- 'Lunar' Excavators required >300

# Winning options

- Greenfields sampling
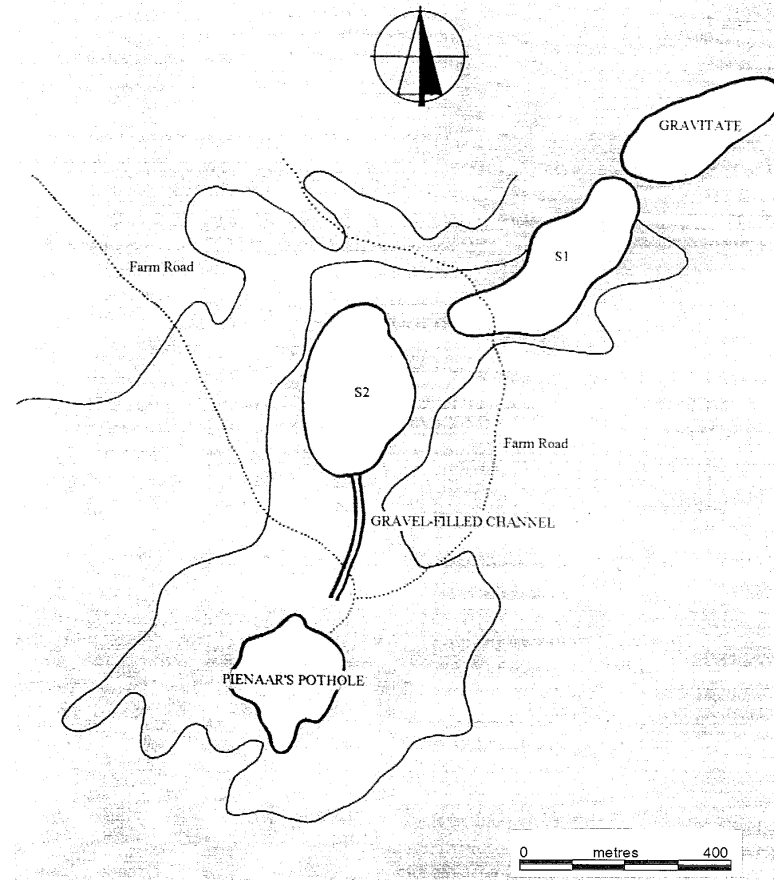
# Winning options

- Crack filling for coal burn dumps

# Winning options

- Clean up in sensitive areas

# Winning options

- Pothole mining

## Secondary options

- Top soil removal
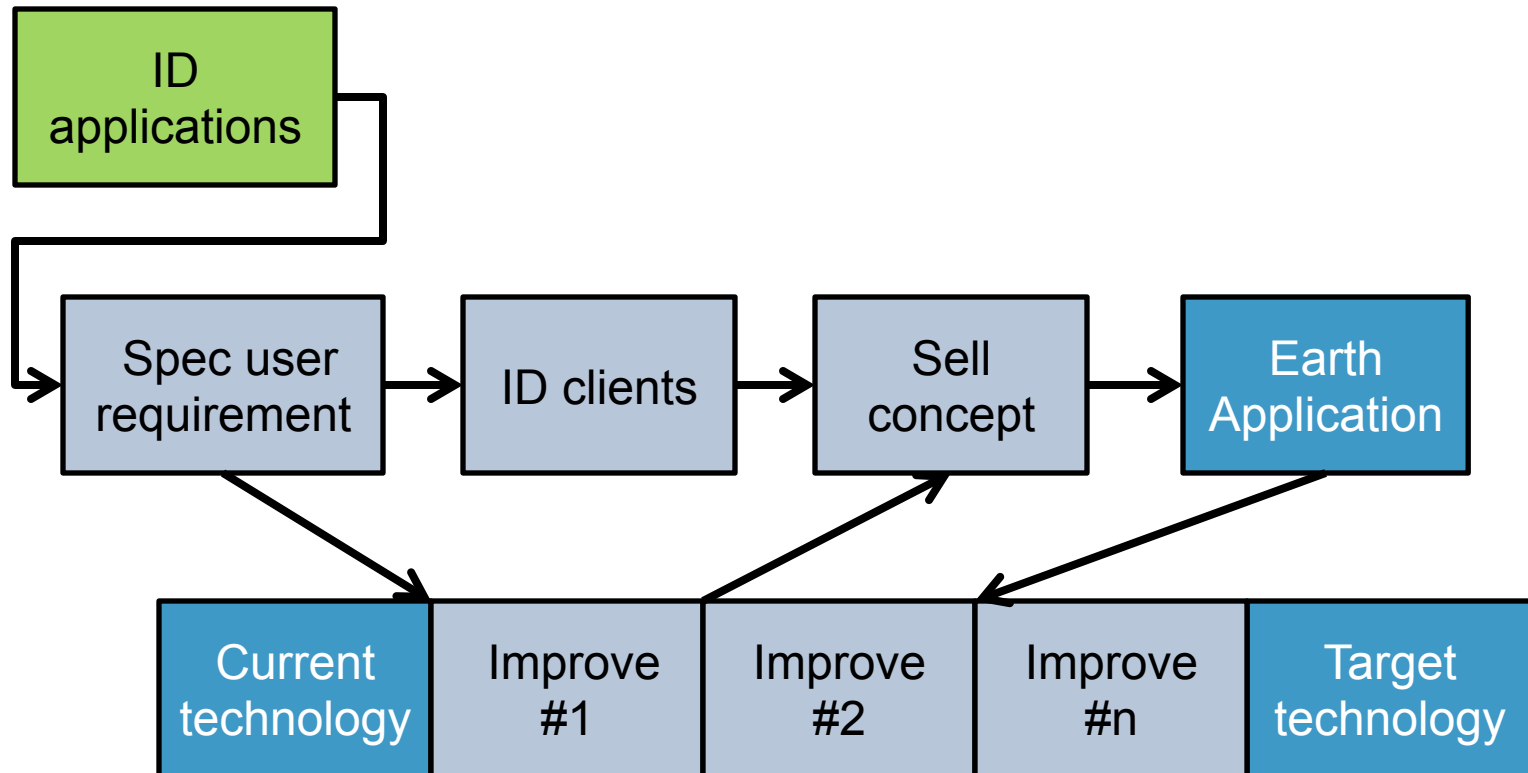- Scavenging mining losses
- Narrow stope vamping

# Tertiary options

- Scavenging outside mineable limits
- Narrow stope production
- Micro mining

# Conclusion

- Pre-empting spin-offs could advance space mining technologies
- Lunar excavation robotics could have earth spin offs
- Should target high flexibility, low throughput applications
- Identified options for further work
- Process applicable to more technologies / fields

# Way forward

# Feedback / Questions?