Implats – Impala Rustenburg operations

# FOGAP EXOSKELETONS RESEARCH

## UNDERGROUND PILOTING OF EXOSKELETONS

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# BACKGROUND

- In 2021, barring contributed 30% of activities conducted during FOG fatalities
- FOGAP undertook a mission to identify ways to make barring safer
- In 2022, exoskeletons were identified as one of four types of technologies with high potential to improve barring.
- This presentation aims to highlight the journey of the exoskeletons research and to report on the latest updates

# UNDERSTANDING EXOSKELETONS





- Wearable strength enhancing suits
- Generally used in factories in many shapes and forms
- Arm support exoskeletons more suitable for barring
- Hypothetically, enhancing the strength of barrers will reduce fatigue
- This could improve the quality, safety and efficiency of barring



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# THE JOURNEY

**2023**

**Exoskeleton technology research with RIIS**

8 high potential commercially available exoskeletons were shortlisted

**Exoskeleton procurement**

4 Exoskeletons Procured

**2024**

**Tests at UJ(Muscle activation)**

- 2 of 4 Exoskeletons tested
- 6 Participants

**Aim:** Proving strength enhancement

Exoskeletons reduced muscle activation, while increasing the strength and endurance of the miners

**2025**

**Preliminary Tests at Sibanye**

- 11 Participants
- 2 Exoskeletons tested

**Aim:** Prove feasibility in a barring simulation

Outcomes 70% positive, but inconclusive due to insufficient sample size

**2026**

**Extended Tests at Sibanye**

- 24 Participants
- 2 Exoskeletons tested

**Aim:** Repeat barring simulation with more participants

75% Showed some improvement on one or both exoskeletons

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# BARRING SIMULATION METHOD

- The simulated environment consisted 10 holes at different heights
- Participants performed multiple laps using a 5,5 kg pinch bar
- The test duration was 10 minutes
- Heart rates were measured continuously
- Productivity and efficiency metrics were calculated
- The test was done for baseline, exoskeletons 1 and 2

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# FOGAP PILLAR 2:
## Research & Development - Exoskeleton Testing

Sibanye Stillwater

Watch video >



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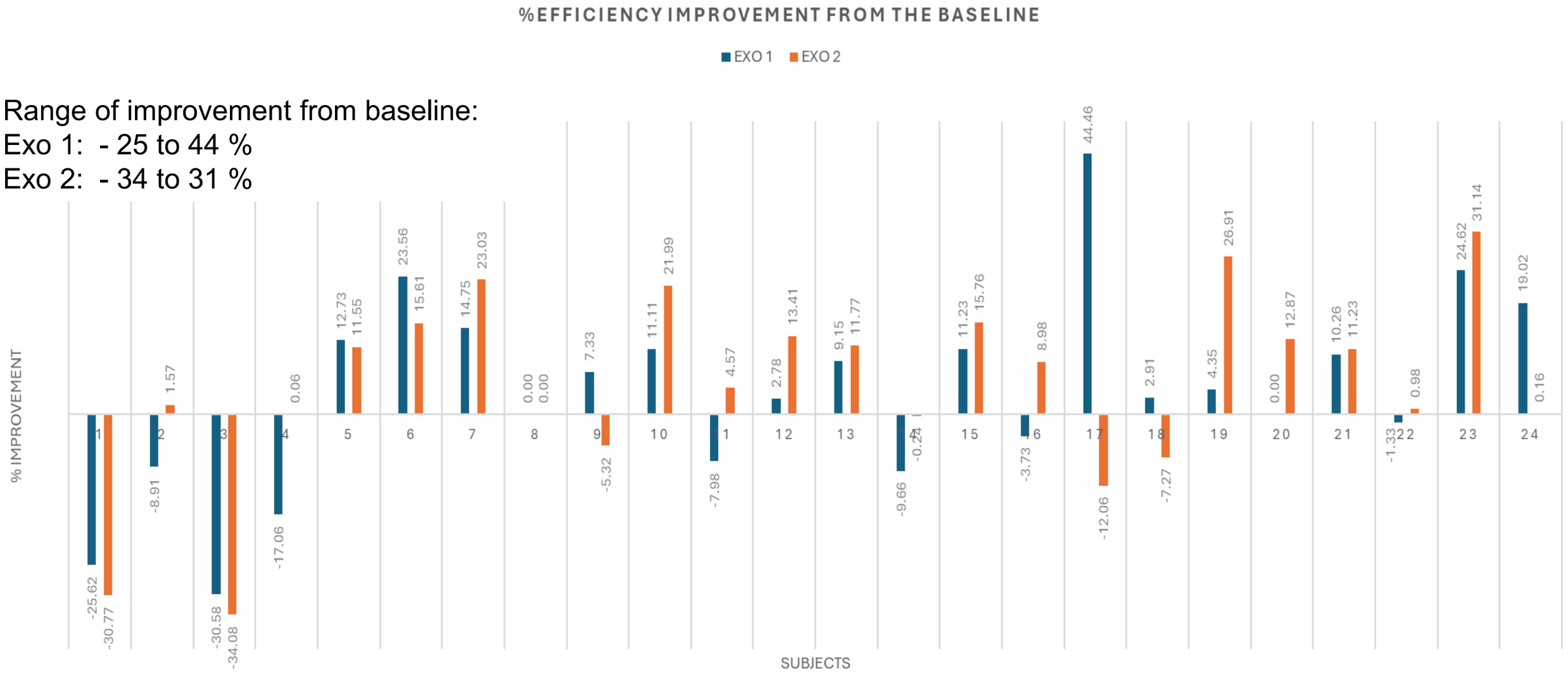
# OBSERVATIONS

- Participant discomfort and frequent adjustments during assessments
- Participants still utilize some strength to retract their arms during barring
- Lifting the pinch bar for extended periods is easier with the exoskeleton

Range of improvement from baseline:
Exo 1: - 25 to 44 %
Exo 2: - 34 to 31 %



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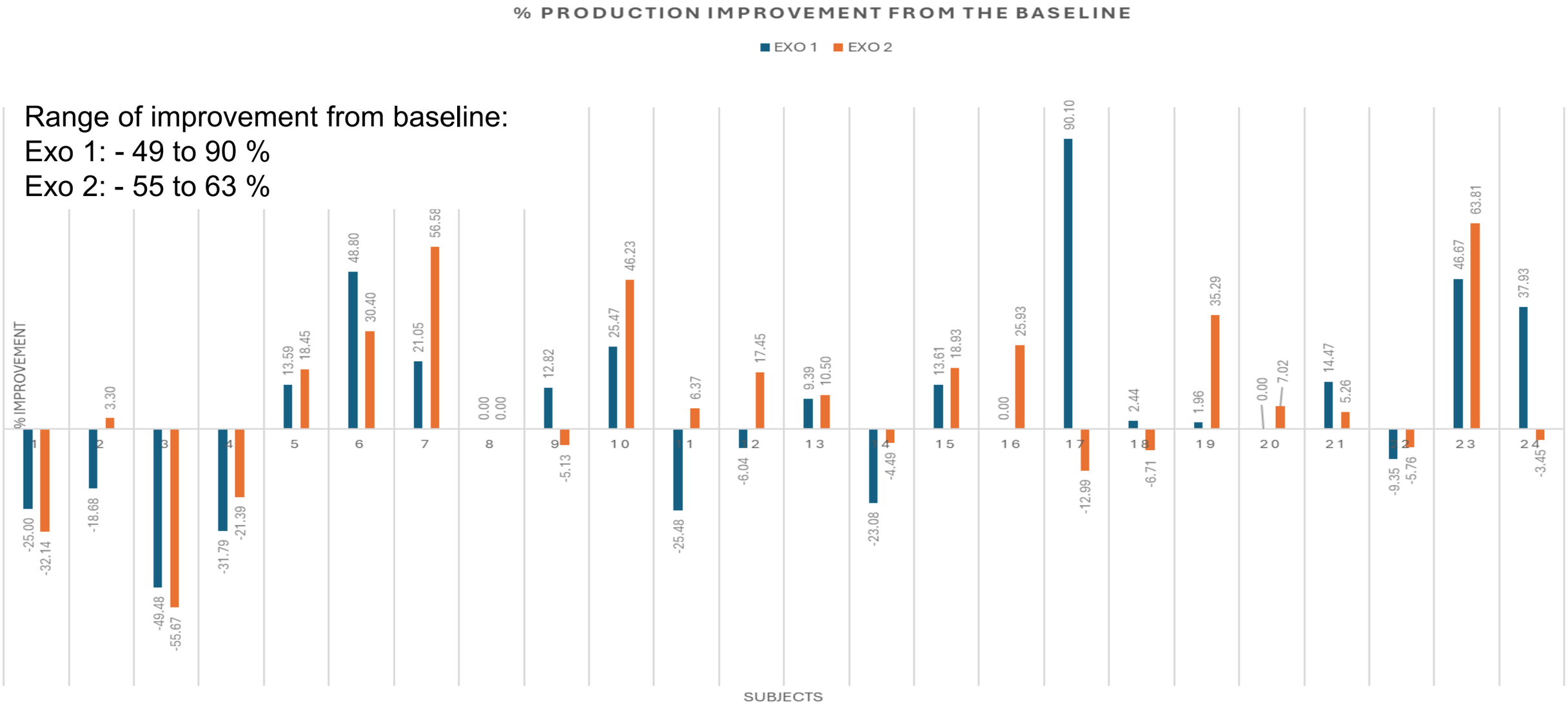


Range of improvement from baseline:
Exo 1: - 49 to 90 %
Exo 2: - 55 to 63 %



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# AVERAGE PERFORMANCE

| Measurements | Preliminary tests | | Extended tests | |
|---|---|---|---|---|
| | Exoskeleton A n = 11 | Exoskeleton 2 n = 11 | Exoskeleton 1 n = 24 | Exoskeleton 2 n = 24 |
| Average % Efficiency improvement from baseline | 1.1% | 7.3% | 4.2% | 5.3 % |
| Average % Productivity improvement from baseline | -1,0% | 7.5% | 5.3% | 9.2% |



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# CONCLUSIONS

- Improvement in productivity and efficiency where fitting was not an issue
- Effective integration into mining operations will require substantial redesign
- Average improvement range from 4-9%
- A fit-for-purpose design could lead to more improvement

# WAY FORWARD

- Testing the Exoskeletons in a controlled underground environment as part of a change management risk assessment
- Partnering with willing suppliers to design fit-for-purpose exoskeletons


Glencore Coal - Tweefontein

# Thank you

# #MiningMatters

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