Implats – Impala Rustenburg operations

# FOGAP RESEARCH

## EXOSKELETON UNDERGROUND TESTS

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- Eric Mofokeng – Strata Control Officer



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# STUDY OBJECTIVES

- Investigate exoskeleton viability for fatigue reduction during barring
- Identify short comings of tested products



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# UNDERGROUND TESTS DETAILS

- Western limb platinum operations- Sibanye Kopaneng Mine
- Bord and pillar mining environment with average width of 2.5m
- Two exoskeletons tested
- Data was collected in a form of  qualitative questionnaires
- 100 Participants tested



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# THE JOURNEY

**2023**

**Exoskeleton technology research with RIIS**

*Eight exoskeletons were shortlisted.
*Four Procured

**2024**

**Tests at UJ(Muscle activation)**
- 2 of 4 Exoskeletons tested
- 6 Participants

**Aim:** Proving strength enhancement

Results proved that exoskeletons reduced muscle activation

**2025**

**Extended Tests at Sibanye Gold**
- 35 Participants
- 3 Exoskeletons tested

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

75% Showed some improvement on one or both exoskeletons

**2026**

**Underground Tests (Sibanye Platinum)**
- 100 Participants
- 2 Exoskeletons tested

**Aim:** Confirm viability in a real environment



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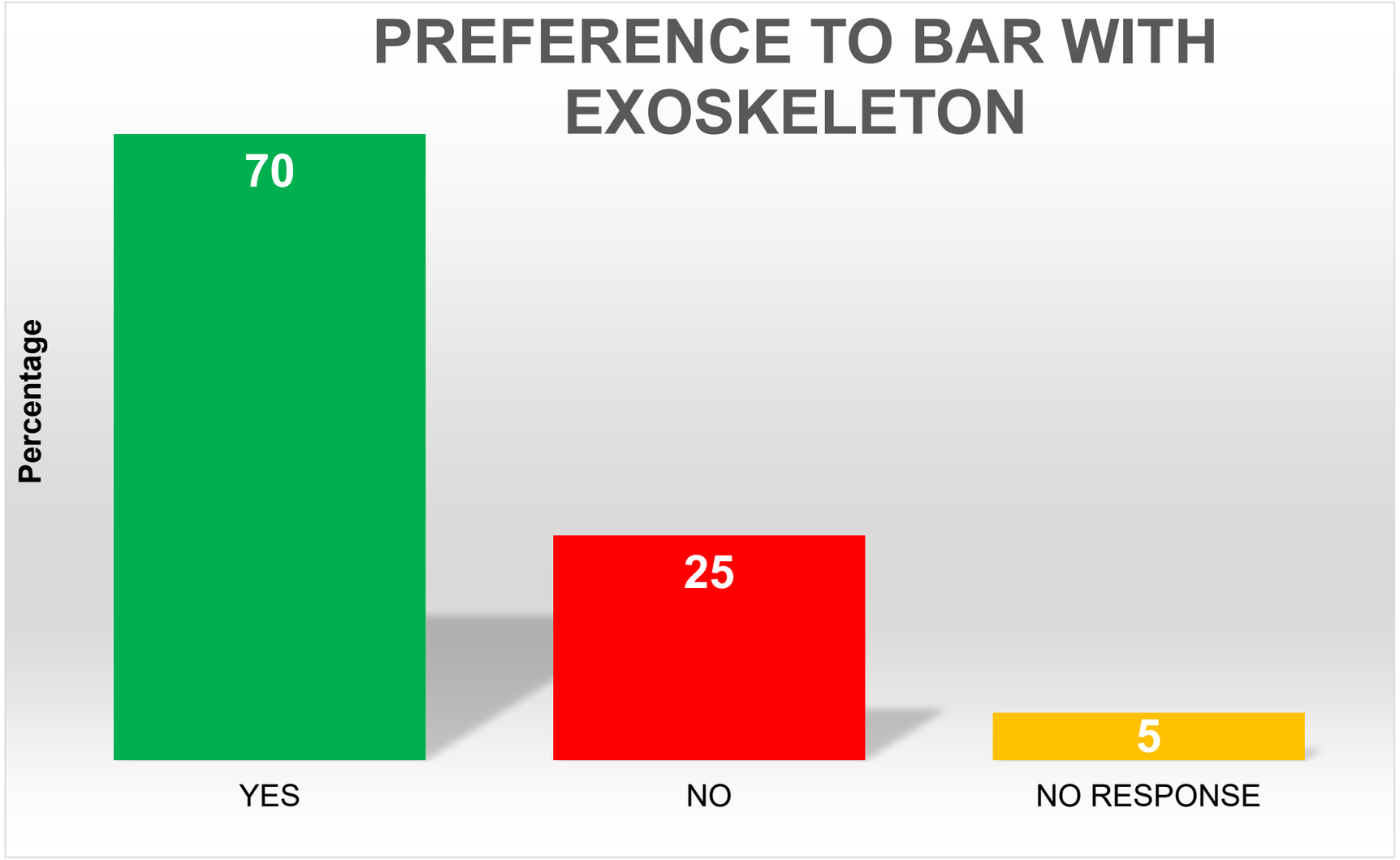


## Take aways

- This validates the need to develop mining adapted exoskeletons
- The current products are promising, but not mining ready



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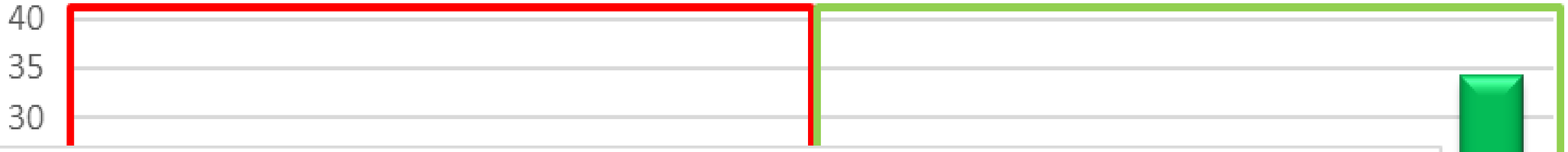
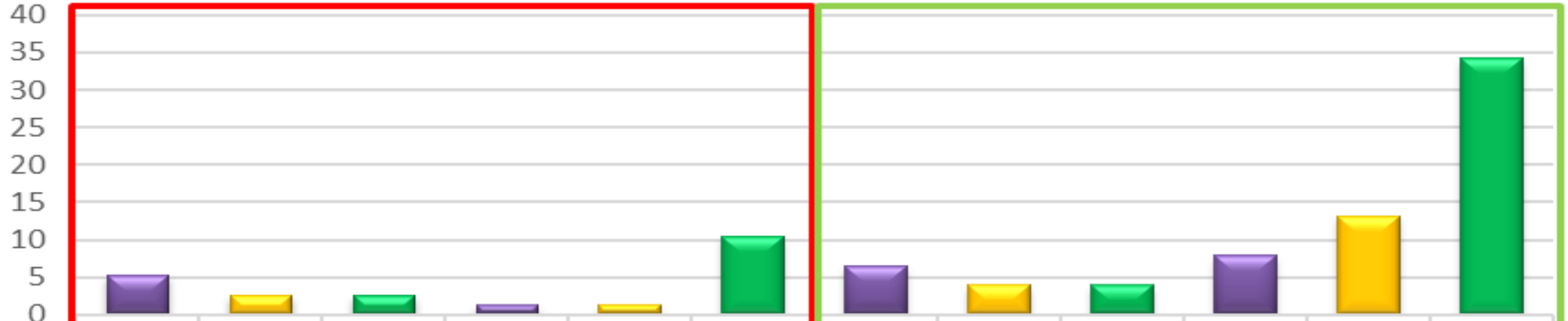
# Fit Vs Preference Vs Efficiency




Fit Vs Preference Vs Efficiency




| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Efficiency | N | SAME | Y | N | SAME | Y | N | SAME | Y | N | SAME | Y |
| *Preference | N | N | N | Y | Y | Y | N | N | N | Y | Y | Y |
| *Good Fit | N | N | N | N | N | N | Y | Y | Y | Y | Y | Y |
| % of Total (76) | 5 | 3 | 3 | 1 | 1 | 11 | 7 | 4 | 4 | 8 | 13 | 34 |



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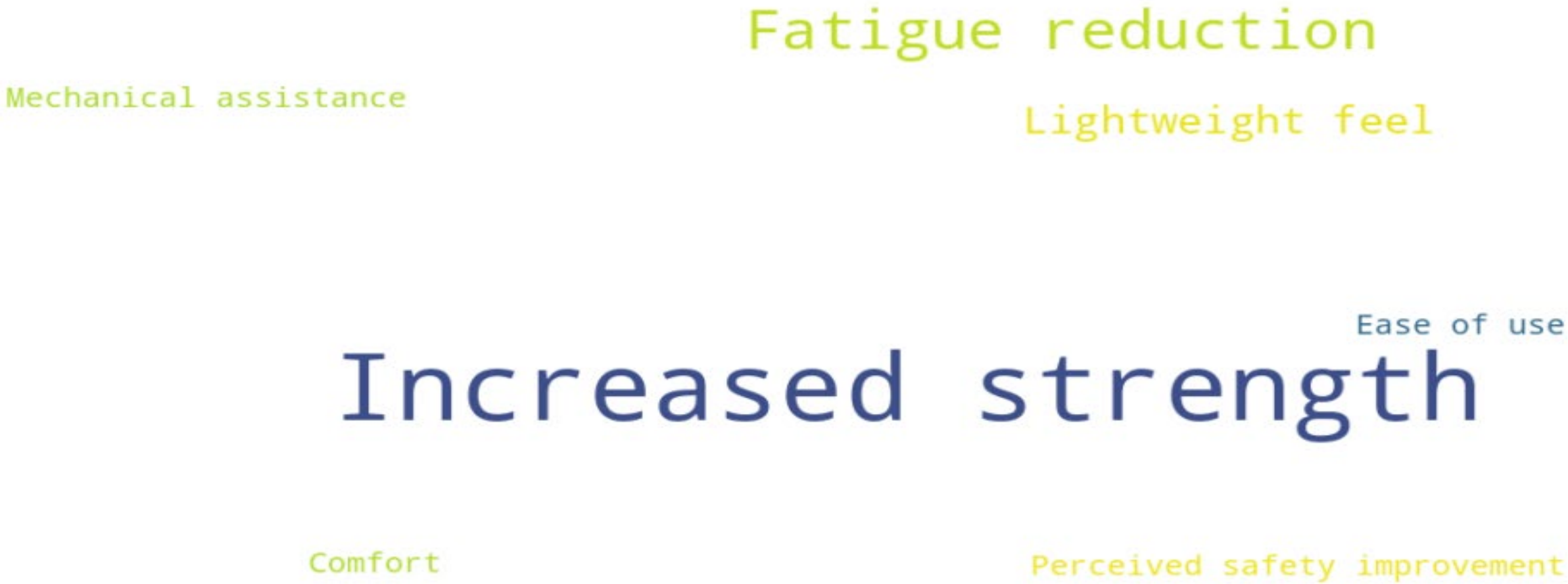
# WHAT DO PARTICIPANTS LIKE ABOUT THE EXOSKELETON?



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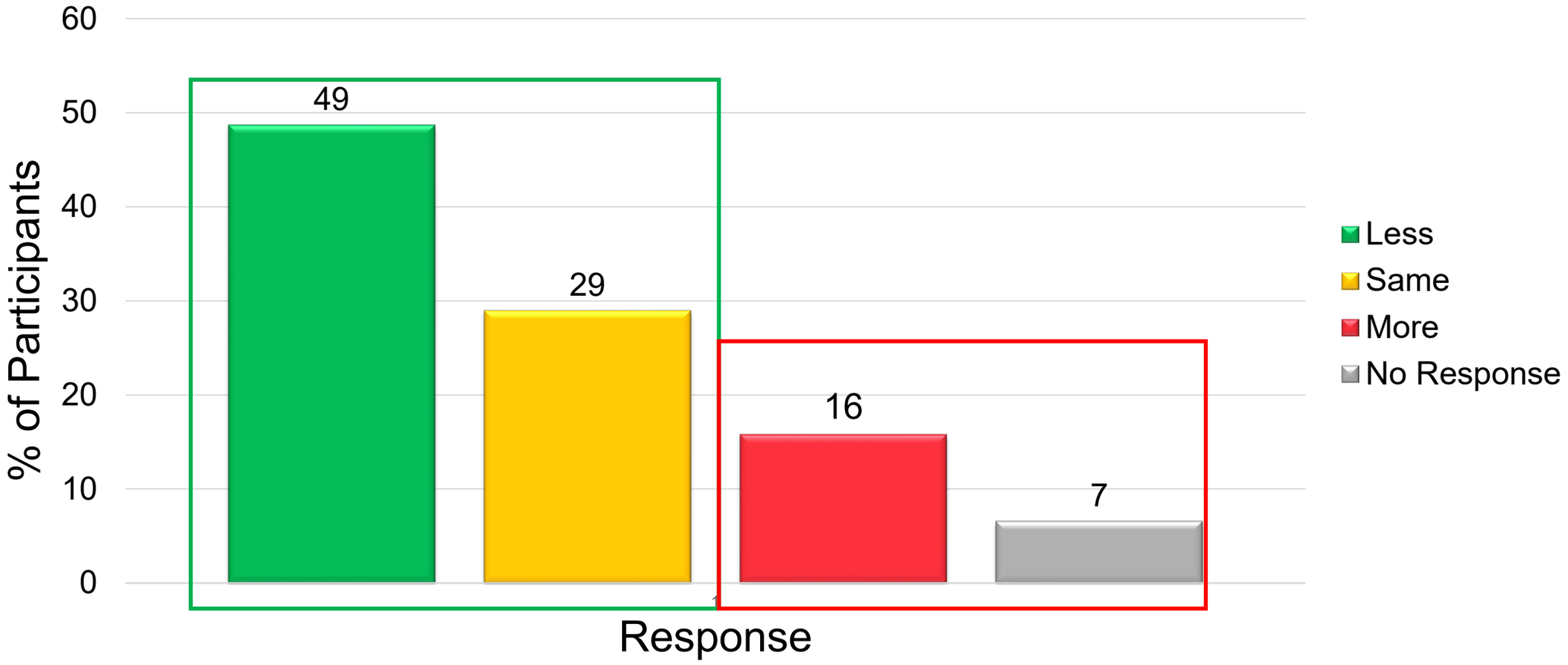
# FATIGUE WHILE WEARING EXOSKELETON




- Half experienced reduced fatigue
- Only a small minority experienced worse fatigue.



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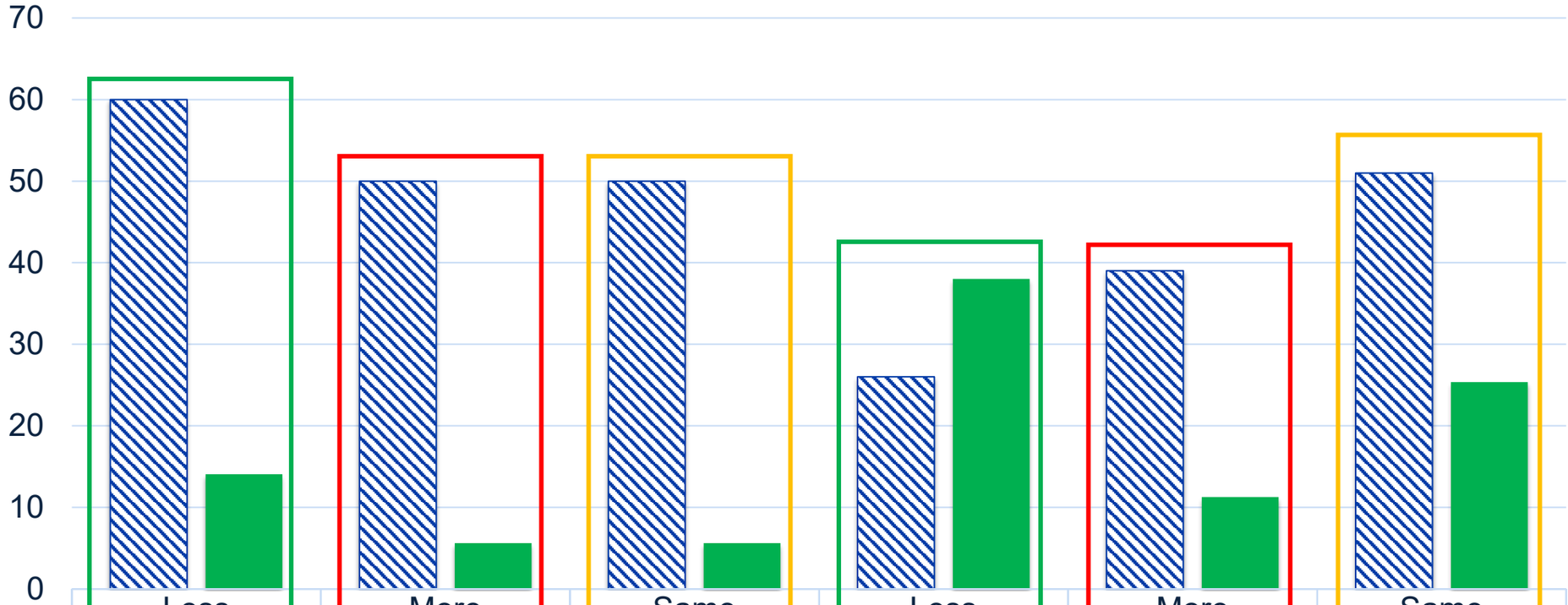
# FIT VS FATUGUE VS MEAN ADJUSTMENTS/HR




| Fatigue | Less | More | Same | Less | More | Same |
|---|---|---|---|---|---|---|
| Good Fit | N | N | N | Y | Y | Y |
| 10xMean Adjustments/hr | 60 | 50 | 50 | 26 | 39 | 51 |
| % of Participants (Excl NAN) | 14 | 6 | 6 | 38 | 11 | 25 |

- Good Fitting-Less Fatigued has the highest % of Participants and lowest adjustment rate
- The Poor Fits have the highest adjustment rate
- But adjustment issues do not over-rule the benefits (echoed by N-Less)



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# WHAT CAN BE DONE TO IMPROVE THE EXOSKELETON?

Improve strap locking system

Waist belt improvement

Easy to carry

Improve adjustability / sizing

Reduce weight

Replace fabric padding with plastic

Make easier to clean

# CONCLUSIONS

## Operational viability

- 50% fatigue reduction
- 70% preference among respondents
- Even poor-fit users benefited
- Both devices show mechanical support effect

## Limitations

- Fit variability; discomfort and adjustment instability



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# WAY FORWARD

- Phase 2 - Testing the exoskeleton with newly procured accessories
- Engaging universities to conduct further research towards developing a fit for purpose product
- Engaging with local suppliers - using our own technical specification
- Challenges: Patent rules



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# 2ND PHASE SETUP: ADJUSTED FOR BARRING

1st Phase Vs 2nd Phase

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Glencore Coal - Tweefontein

# Goodbye

# #MiningMatters


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