Mine Gold.
Create Value.

Austmine 2019 Mining Innovation Conference Presentation

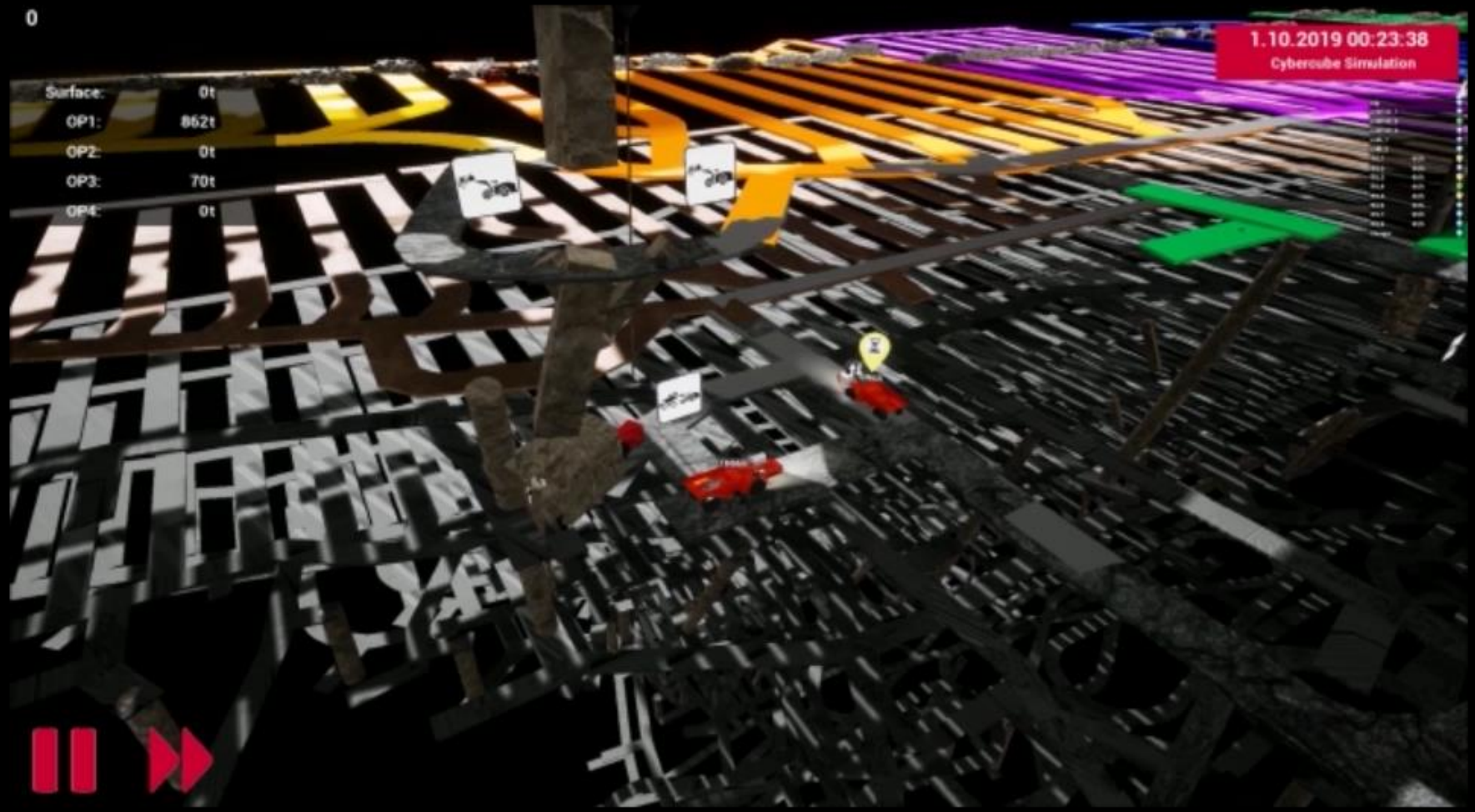
John Welborn | Managing Director & CEO

"I want to find a bold and innovative way to do things the same way its been done for the last 25 years."

Syama Automation Project

Mining Smarter with Advanced Technology

Resolute



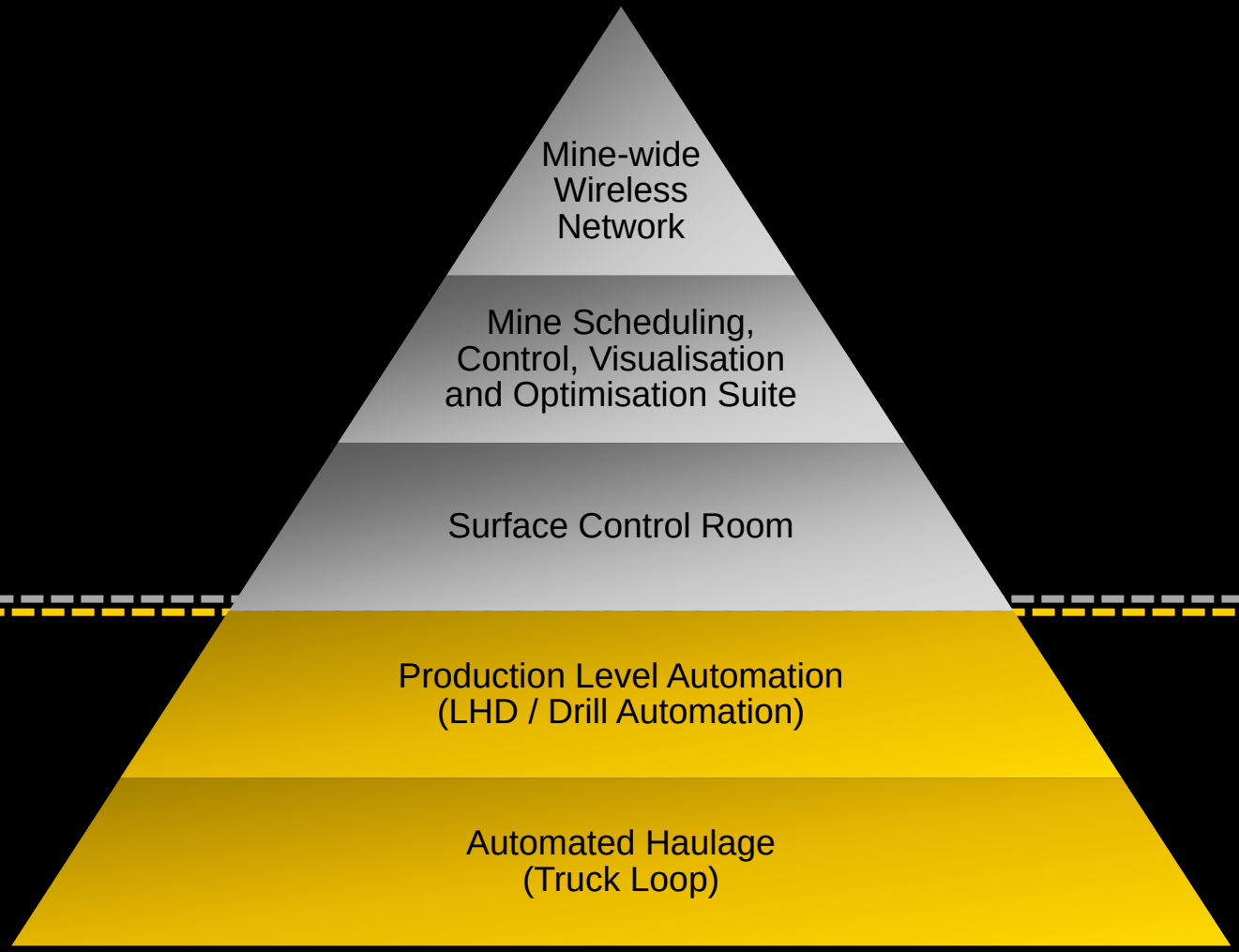
Syama Automation Project
Major components

PHASE 1: MINE DIGITALISATION

PHASE 1 Capability delivers the completed control room with connection to the underground wireless network and the ability to schedule, control and monitor MANUAL underground activities in real-time.

PHASE 2: AUTONOMOUS PRODUCTION AND HAULAGE

PHASE 2 Capability delivers AUTOMATED LHD and DRILL Production on the levels and AUTONOMOUS truck haulage from the 1055 level to the surface ROM



Syama Automation Project

Phase 1

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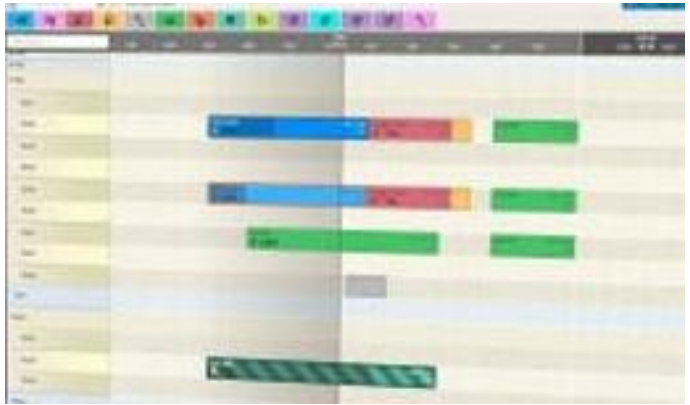
Control Room + Network + OptiMine **= Efficiency**

Both declines, and the 1105 and 1130 production levels will be connected to the visualisation system in the control room which will enable:

- Visualisation of mine and fleet (equipped with tracking units)
- Efficiency gains for production fleet
- Production gains for haulage fleet fitted with OptiMine units
- Remote production drilling
- Real-Time production data
- Real-Time dispatch
- Effective cave management



Syama Automation Project
Phase 2

Resolute

Automated Haulage Loop - **The Main Game**

- The Automated Haulage Loop is the “Main Game” in terms of Syama’s delivered benefit from innovation.
- It gives us the ability to haul ore 24 hours a day / 7 days a week.
- Traffic is managed by a centralised server which increases the throughput over manual hauling.
- Higher production rates over more hours per day = more tonnes.

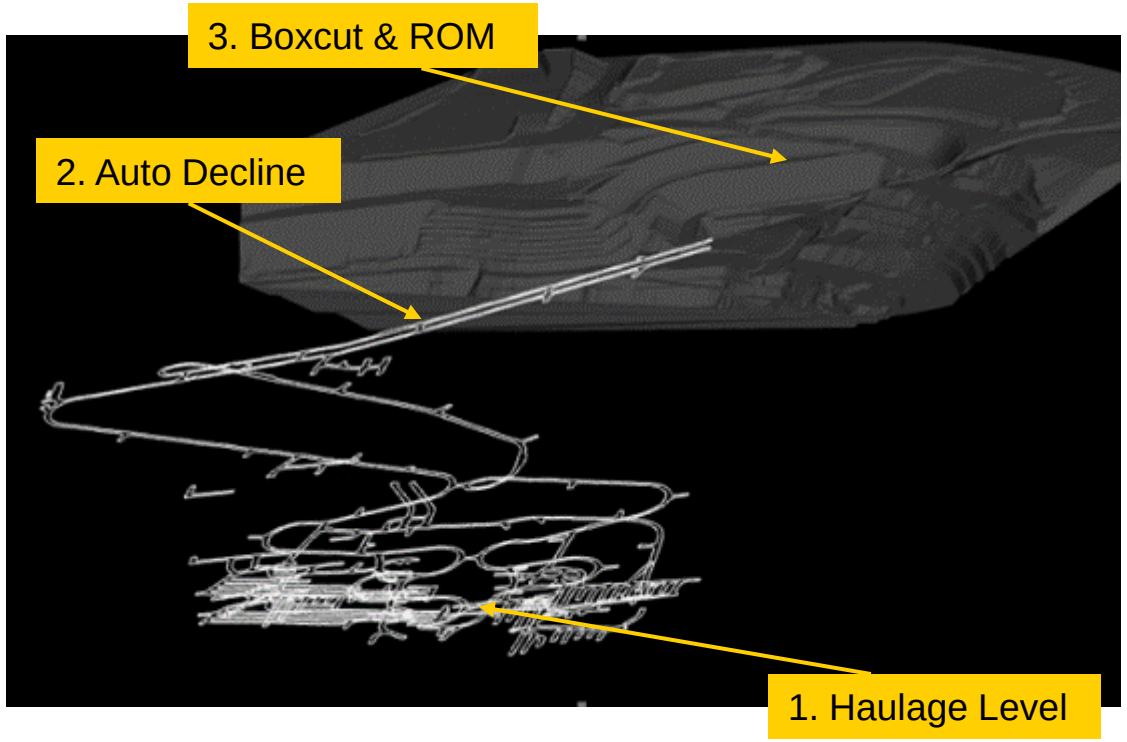
Syama Automation Project
Phase 2

Resolute

Automated Haulage Loop - **The Main Game**

The Automated Haulage Loop Consists of three sections:

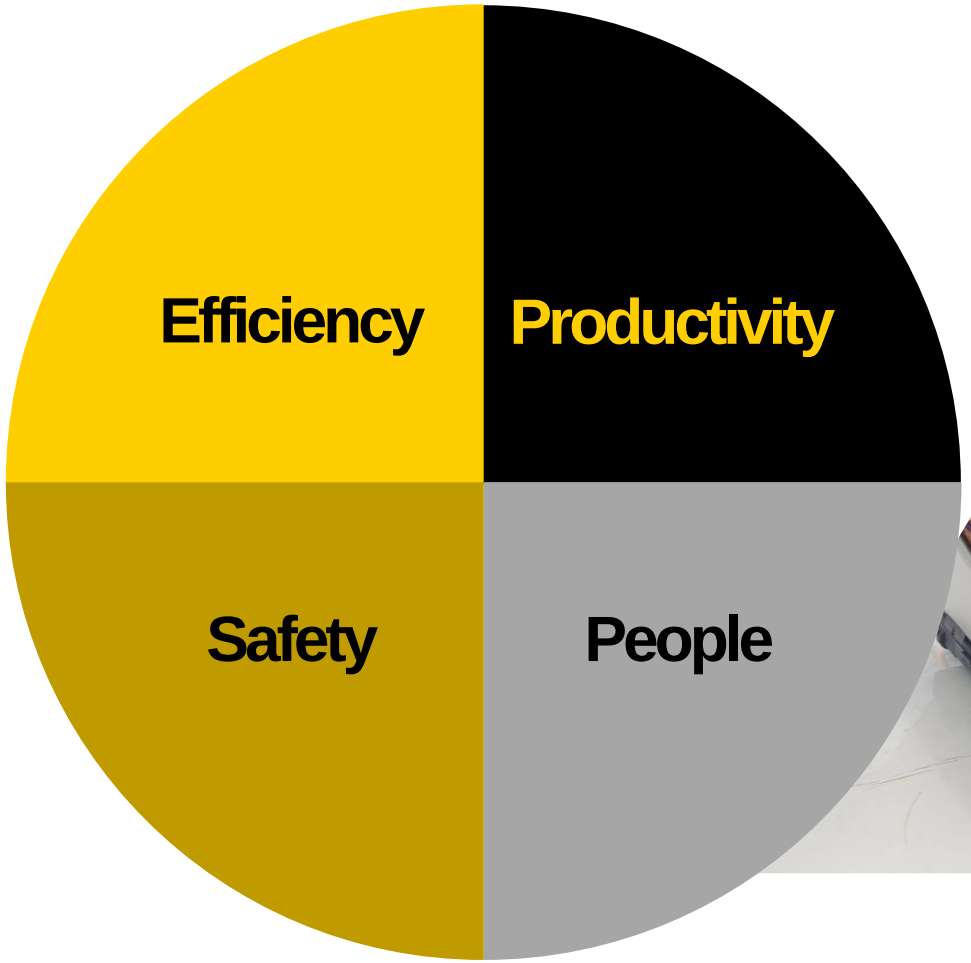
1. **Haulage Level** – This is where the autonomous trucks are loaded underground by the remotely operated LHDs. The ore is taken from the ore passes which are fed by the production levels.
2. **Autonomous Decline** – The mine has a segregated autonomous decline with passing bays where the autonomous trucks make their way to the surface.
3. **Boxcut & ROM** – After leaving the underground mine the trucks tram up the boxcut and to the ROM where they dump.



YOU'RE CRAZY!

Why would anyone try to implement the world's most complex underground mining production automation system in West Africa?

The drivers for automation



The drivers for automation:
Safety

Underground mines present a number of hazards – particularly where there is not a high level of experience. To keep our people safe we will need to limit exposure to hazards:

1. Ground Failure
2. Mud / Fines Rush
3. Vehicle Interactions
4. Whole Body Vibration
5. Dust

The drivers for automation: Safety

The past

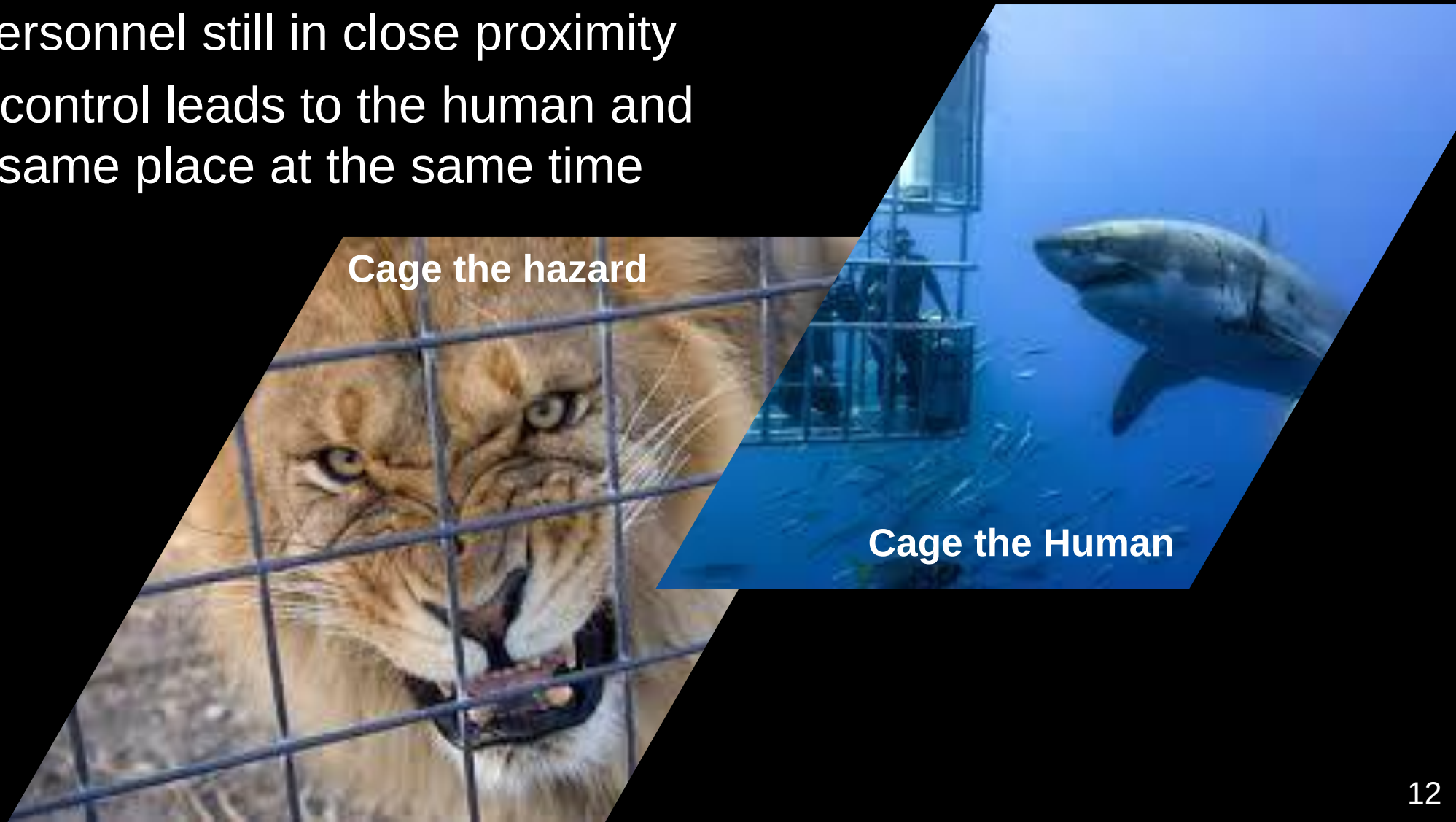
Our Mission is to identify those things we are doing now that people will look back at in 20 years and ask:

“How did we allow that to happen?”

The drivers for automation: Safety

The past: Engineered control

- Hazard and personnel still in close proximity
- Failure of the control leads to the human and hazard in the same place at the same time

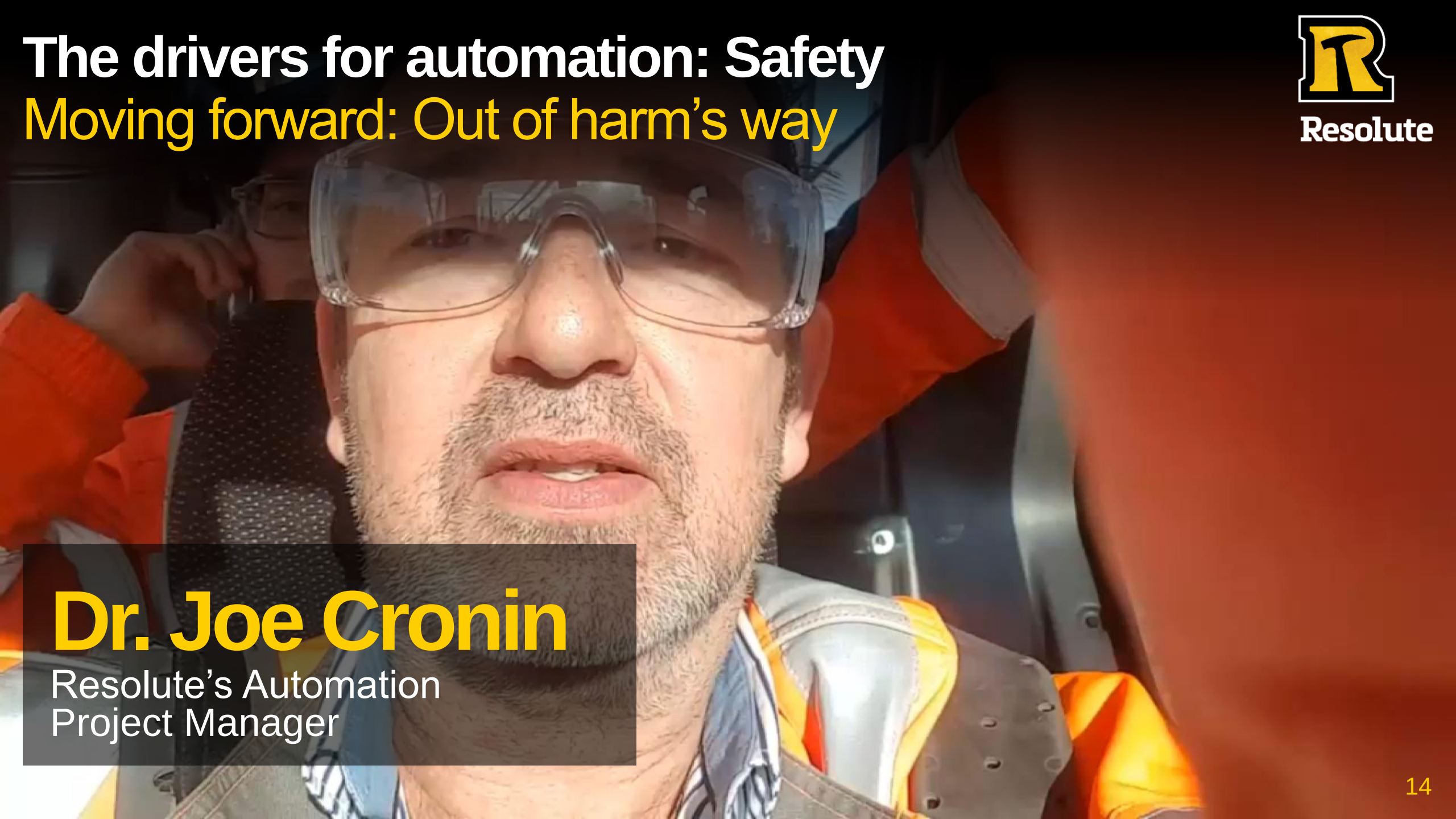


The drivers for automation: Safety

Moving forward: Out of harm's way

The drivers for automation: Safety

Moving forward: Out of harm's way



Dr. Joe Cronin

Resolute's Automation
Project Manager


Resolute
Dr. Joe Cronin
Resolute's Automation
Project Manager

The drivers for automation: Safety

The Future: Operators separated from the level

The drivers for automation:
Efficiency

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Increasing operational efficiency by:

1. The ability to control production at a reliable rate.
2. The ability to optimise the production process
3. Real-Time compliance data
4. The ability to feed back real-time data for closed-loop process control
5. Reduction in operator costs
6. Potential to lower damage costs and downtime as control systems become smarter

The drivers for automation:
Productivity

Higher production rates and greater recovery from:

1. The ability for higher throughput at a greater rate of recovery when operating at optimum parameters
2. The ability to optimise return over a longer period (full production over shift change, blasting and re-entry)
3. The reduction in variability due to operators
4. The ability to selectively produce from drawpoints to optimise grade

The drivers for automation:
Productivity

- Underground productivity is highly variable and dependent on decisions made by personnel and supervisors
- Situational awareness, the ability to communicate and real-time feedback are essential for success

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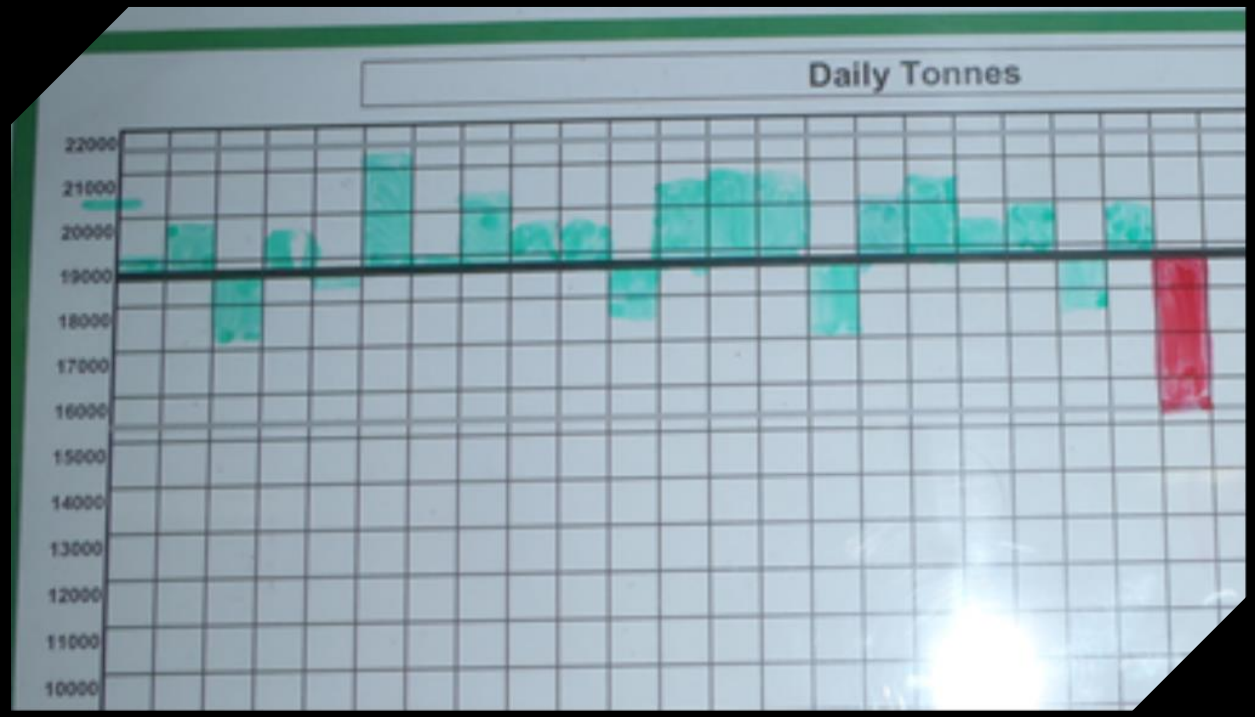
The drivers for automation: Productivity

Moving to real-time feedback

We can look back to see how many Green and Red days we have had, but we don't know WHY!

We need to ask; How are we going right now? What do we need to do to make this day a Green day.



"There's a reason the rear view mirror is so much smaller than the windscreen"

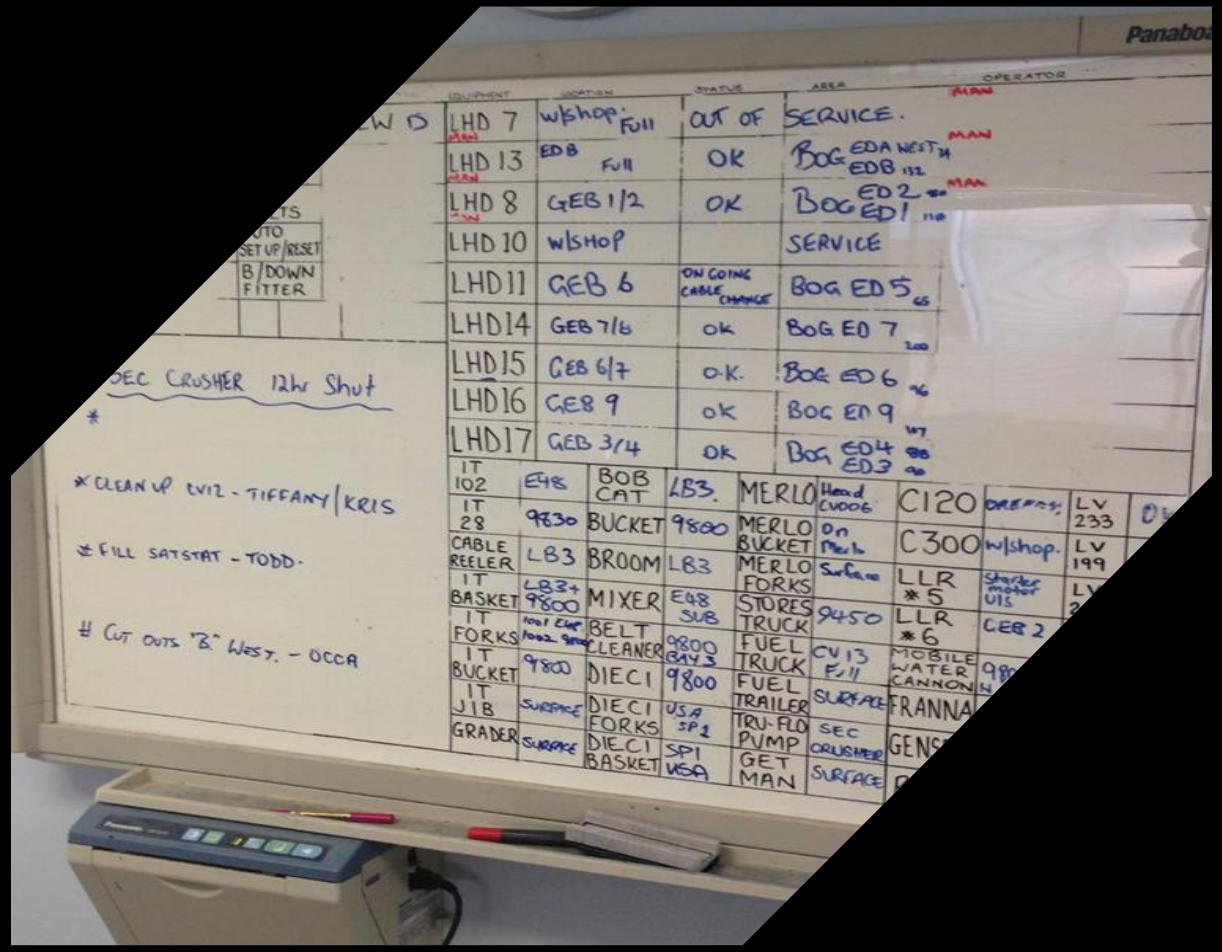
Old Swedish Saying

The drivers for automation: Productivity

Moving from open loop to close loop control

OPEN LOOP: How We Work Now

- Within the first hour, breakdowns will force us to change the plan.
- Too complex to analyse the effect of our decisions in real time.

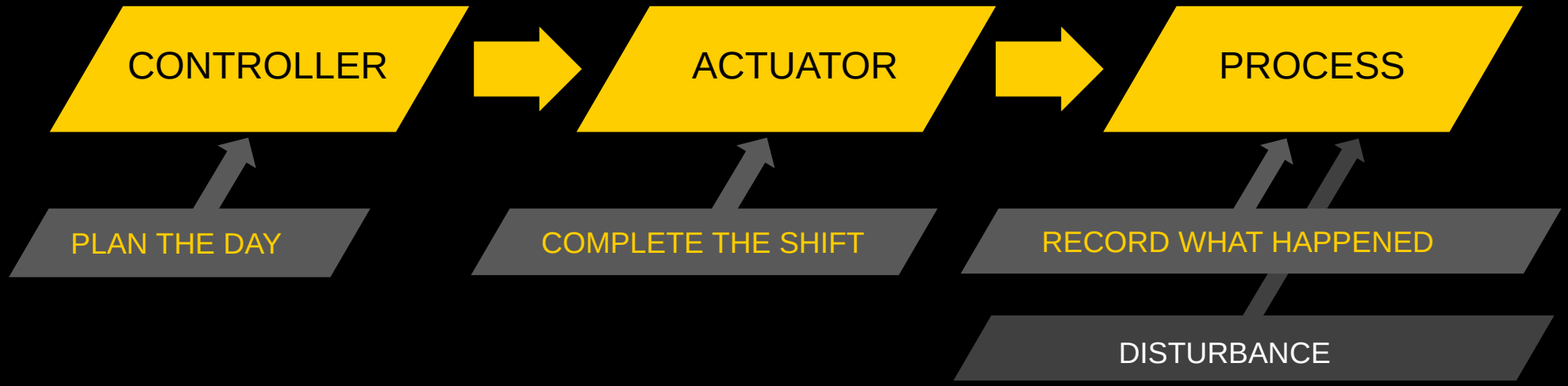


The drivers for automation: Productivity

The past

Moving from open loop to closed loop control

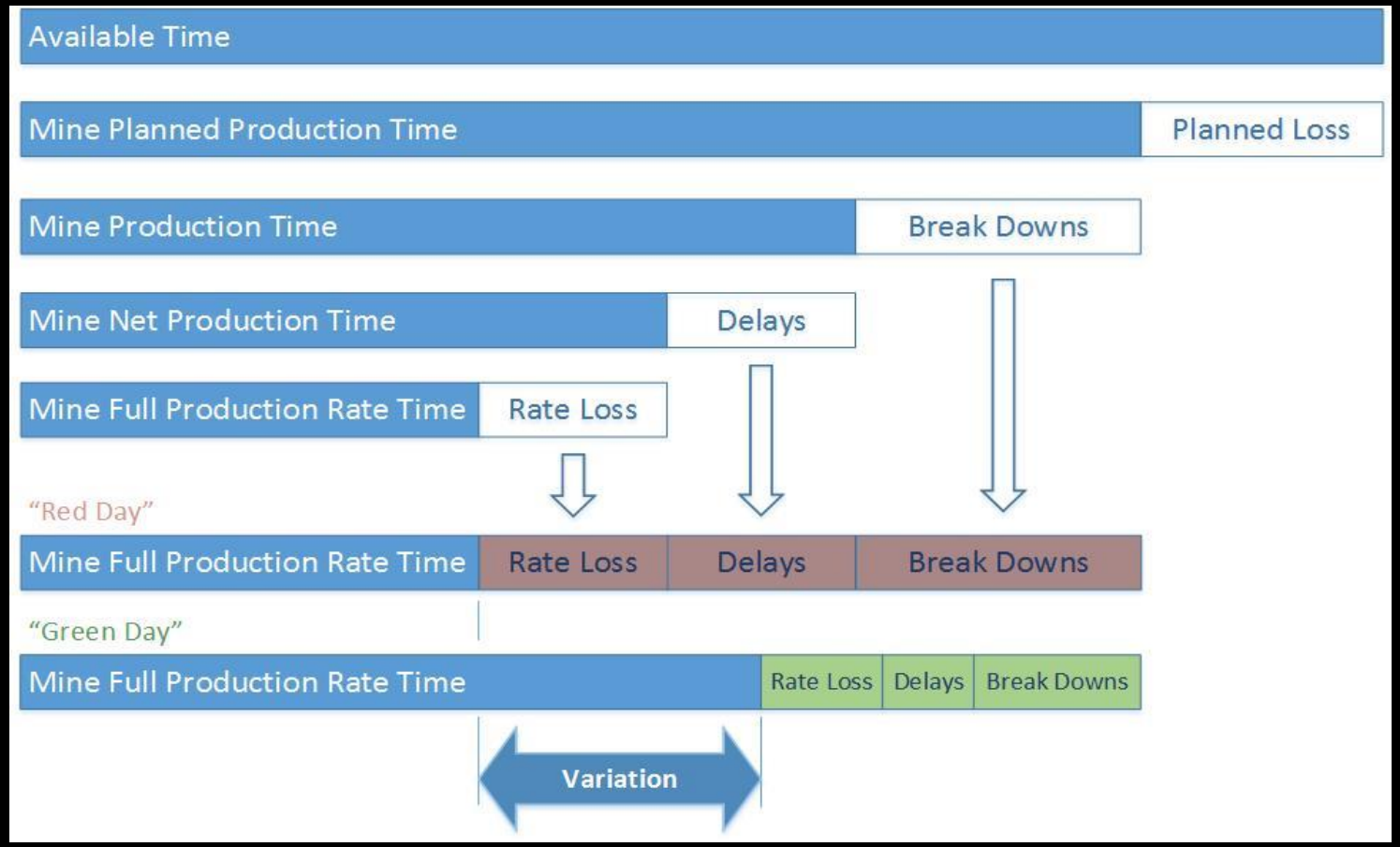
OPEN LOOP: how we have worked in the past



The drivers for automation: Productivity

The ability to control the output

VARIATION IN UNDERGROUND PRODUCTION



The drivers for automation: Productivity

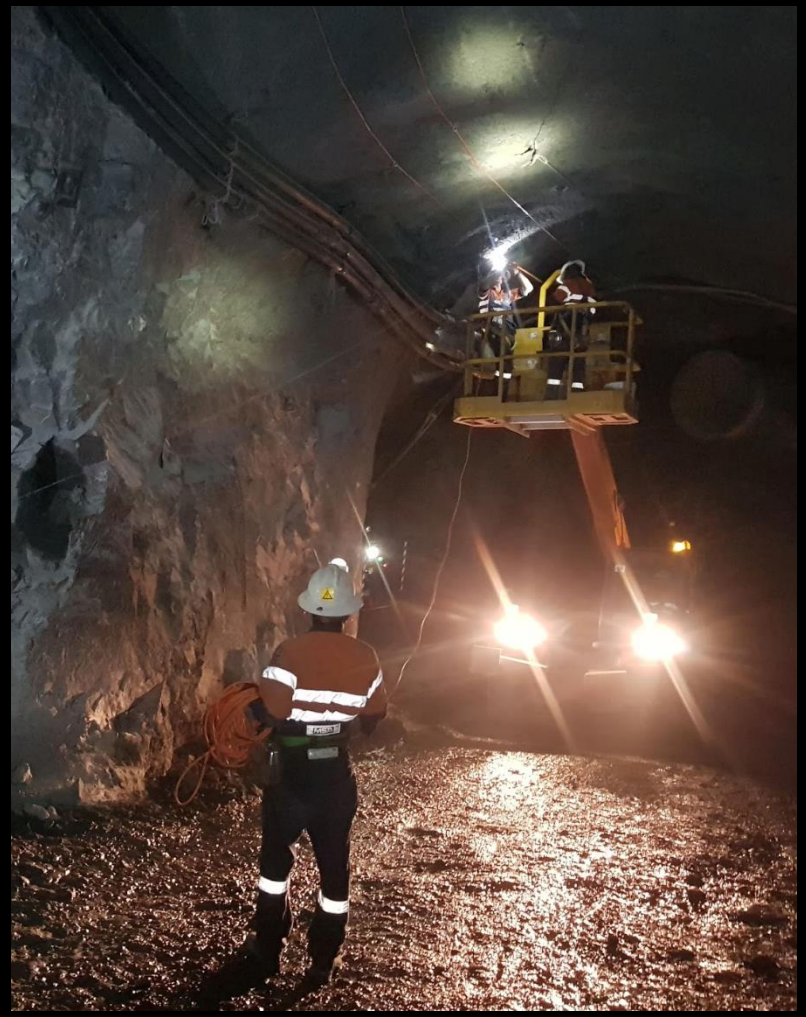
The ability to control the output

Variation in underground production represents a loss of control of our process:

1. DATA
2. SAFETY
3. COSTS
4. SCHEDULING
5. PRODUCTION
6. RISK

The drivers for automation: Productivity

The ability to control the output

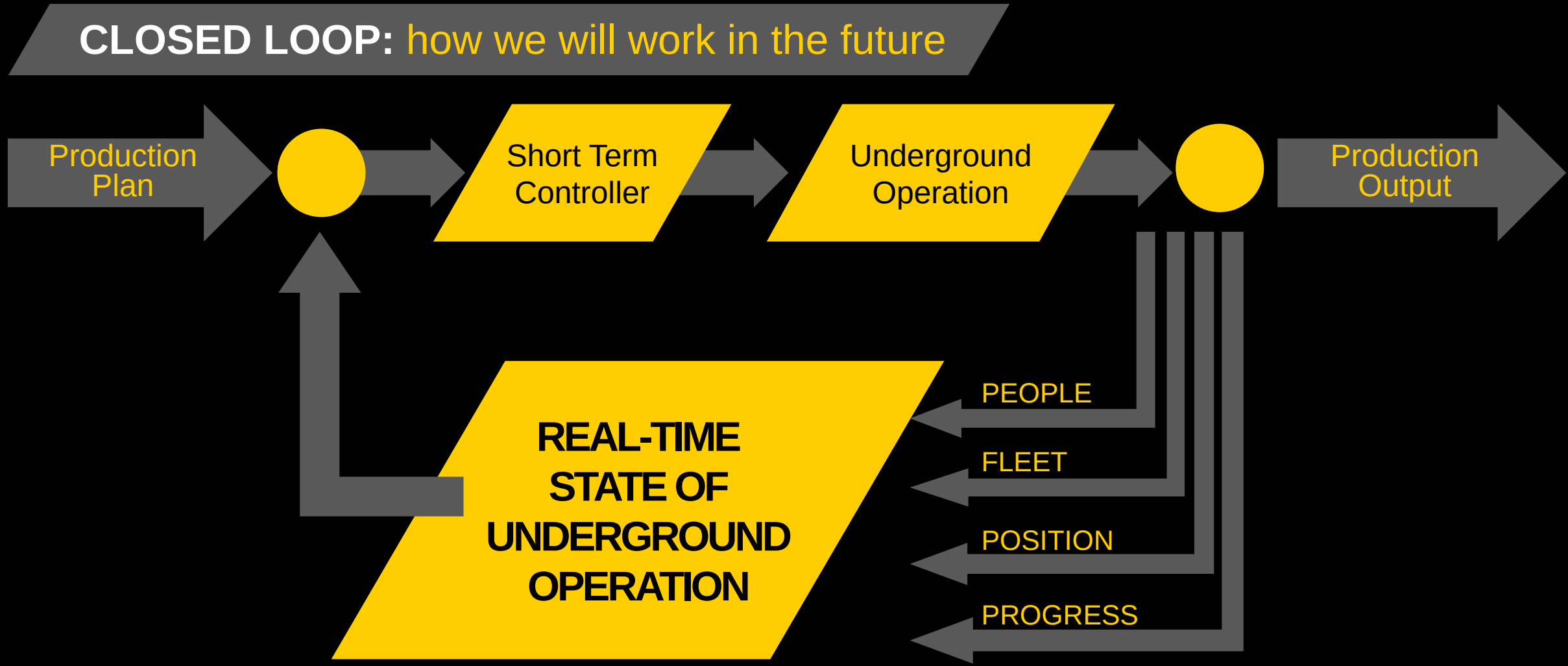


VARIATION reveals itself in

1. Higher INJURY rate
2. Higher operating COSTS
3. Lower and less predictable PRODUCTION
4. Lower UTILISATION OF ASSETS
5. Lower EMPLOYEE ENGAGEMENT

The drivers for automation: Productivity

The future



The drivers for automation:
People

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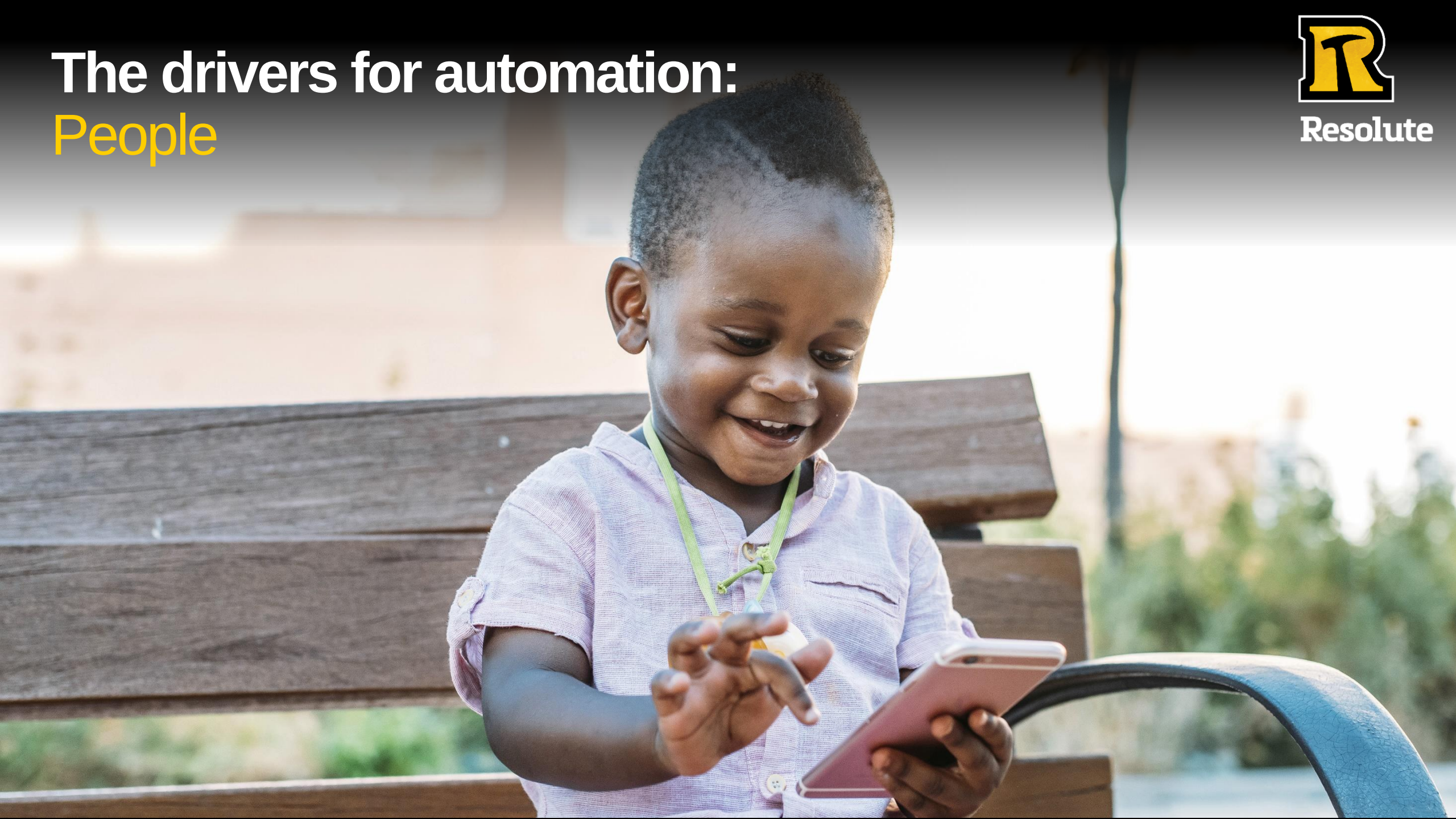
The drivers for automation:
People

The Malian Talent Development Program

The drivers for automation:
People



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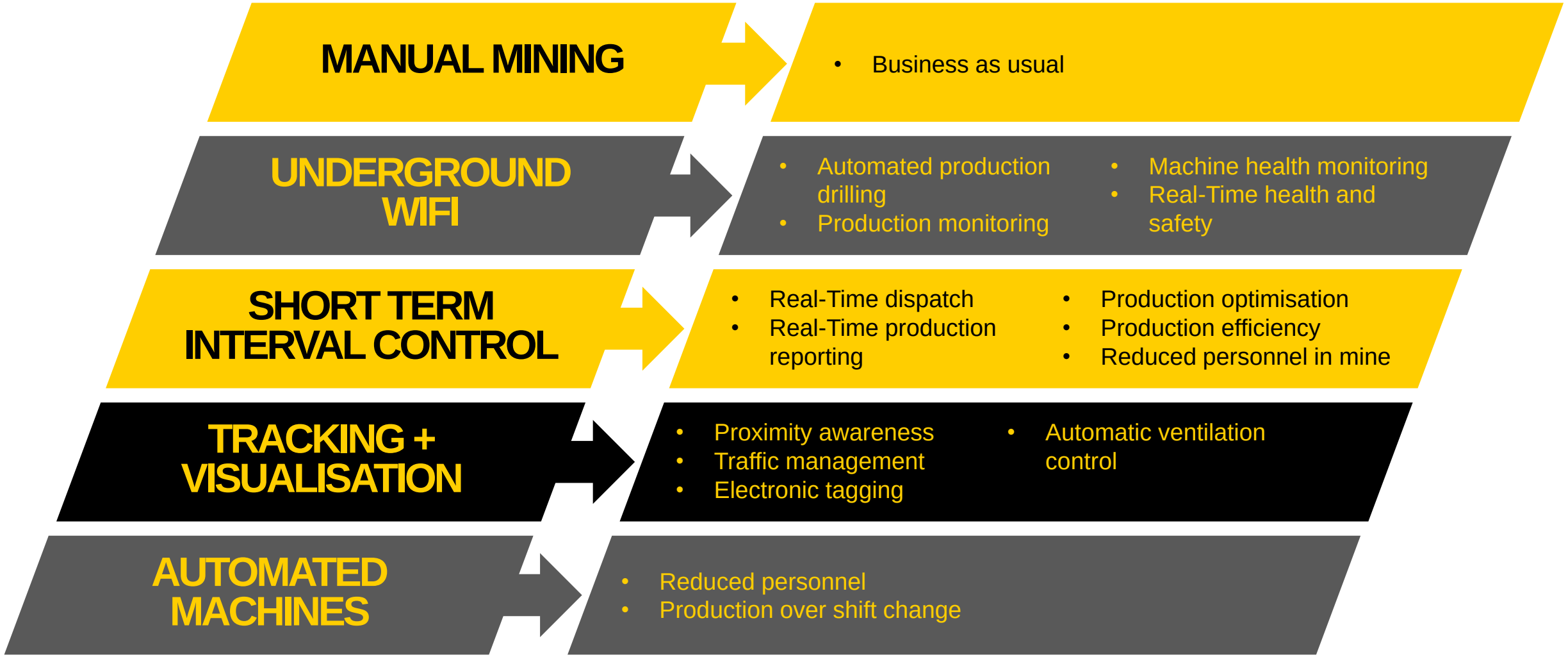
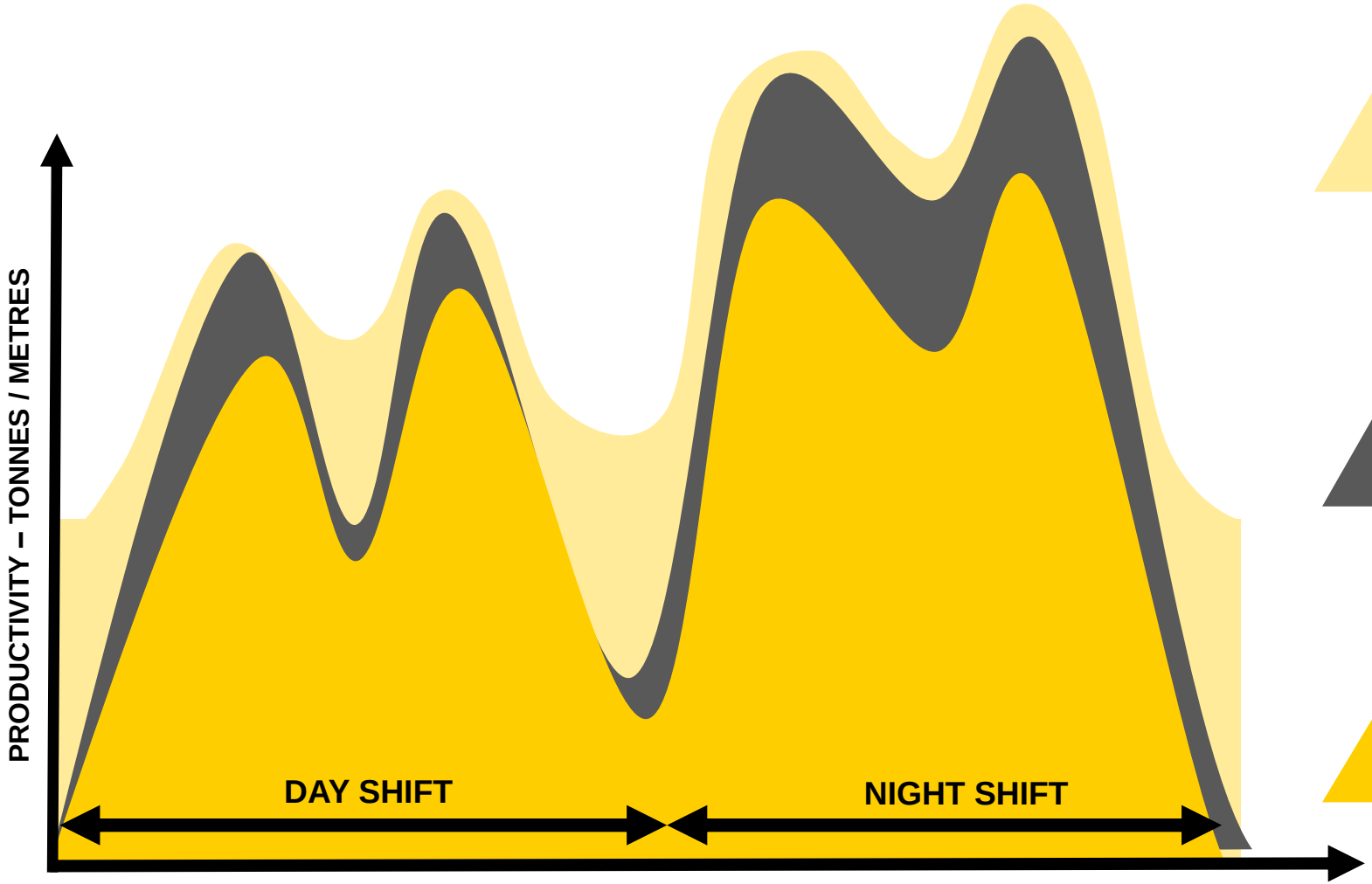
Capability based technology strategy



Optimised automated production

Additional production from technology



AUTOMATED MINE
15% - 20% Gain

- Remotely Operated Machinery
- Autonomous Drilling
- Autonomous Haulage

DIGITAL MINE
10% - 15% Gain

- Tracking and Visualisation
- Task Scheduling and Optimisation

MANUAL MINE

Early Results:
Automated drilling

21%
Increase in drill meters per day

+

>10%
Increase in drilling accuracy

+

Decrease in manual intervention

=

Safe, productive and low cost operation

Syama Underground Mine

Resolute

The World's first purpose built fully automated underground gold mine

You would be **CRAZY** not to !

Resolute

Mine Gold.
Create Value.