

Digitizing Complex Systems with DFOS for Rapid Operational Improvement

4 July 2025



What is Distributed Fibre Optic Sensing ?

As Leaders on the Industry, we need to manage safety, environmental and production risks, here's just two examples:



Tailing Facilities (Structural Failures)

- 18 000 Globally with 3 500 currently in use.
- 1999-2003: 8 failures.
- 2014-2018: 16 failures.
- Just 4 of the deadliest tailing failures in the past 20 years resulted in 661 fatalities.
- **Past year: 6 Failures with 5 fatalities.**



Conveyors (fires)

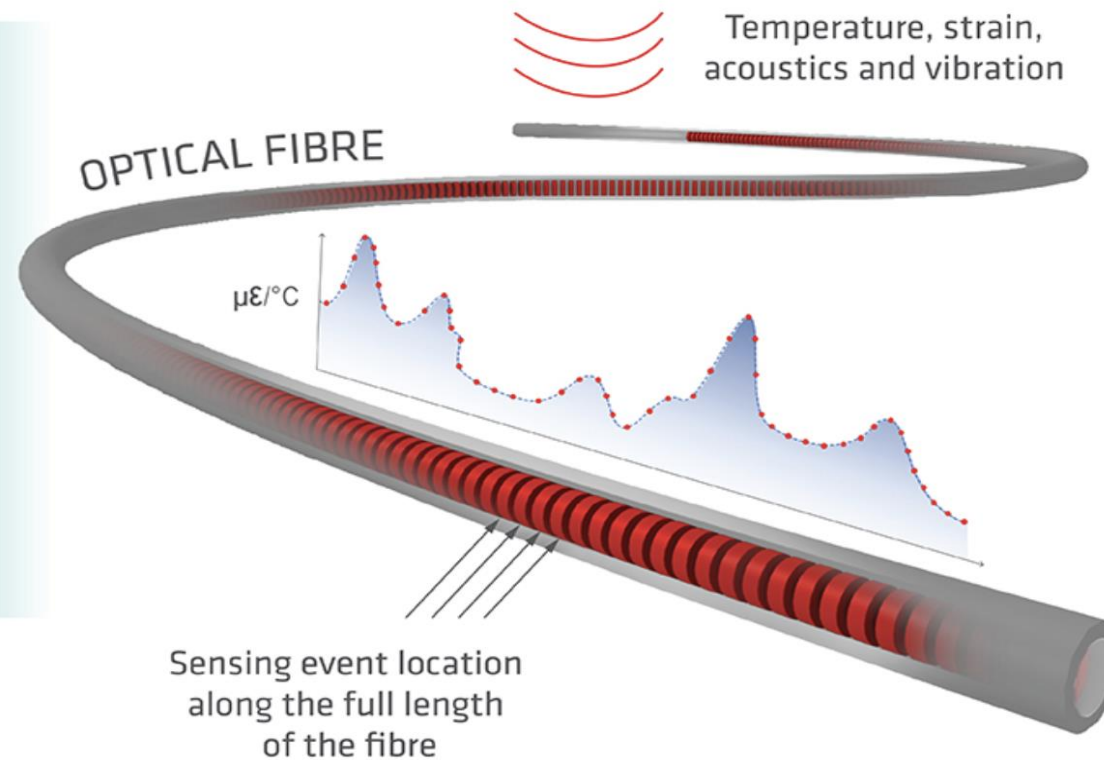
- 27% of all mining losses (insurance Stats).
- >200 Conveyor fires in past 10 years.
- 5 largest conveyor fires caused 360 fatalities and several weeks of production stoppage.
- **May 2023 Yanaquihua Gold Mine = 27 fatalities.**

Mining is inherently risky!

DISTRIBUTED FIBRE OPTIC SENSING

Imagine a digital nerve in your mining operation that can be extended as requirements expand, giving you real-time critical data to reduce safety and environmental risks, increasing equipment reliability and production.

THE FIBRE IS THE SENSOR



Real time mine wide ventilation and fire detection

43%

Underground power usage



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Airborne pollutants, including dust, fumes, and gases generated during mining operations, are a primary concern. Inhalation of these pollutants can lead to respiratory diseases such as pneumoconiosis, chronic obstructive pulmonary disease, and lung cancer. Additionally, exposure to toxic gases can cause acute health effects, including asphyxiation and poisoning.

Noise is another prevalent hazard in mining environments, stemming from heavy machinery, drilling, blasting, and transportation activities. Prolonged exposure to high noise levels can result in noise-induced hearing loss, significantly impacts the quality of life of affected employees, and a common occupational health concern among miners. Besides impairing auditory function, excessive noise exposure may also contribute to stress, communication difficulties, and decreased situational awareness, increasing the risk of accidents and injuries.

Heat stress is a significant occupational health risk in South African mines, particularly in deep-level mining operations where ambient temperatures can increase. Miners working in hot environments face the threat of heat-related illnesses such as heat exhaustion, heatstroke, and dehydration. Moreover, heat stress exacerbates the burden of other health conditions and can impair cognitive function and physical performance, jeopardizing safety and productivity.

HEAT
STRESS



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THE PRINCIPAL INSPECTOR
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MINE HEALTH AND SAFETY INSPECTORATE: GAUTENG REGION

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CELL: +27 (82) 449-5827

Date: 07 May 2024

THE EMPLOYER AT A MINE
GAUTENG REGION

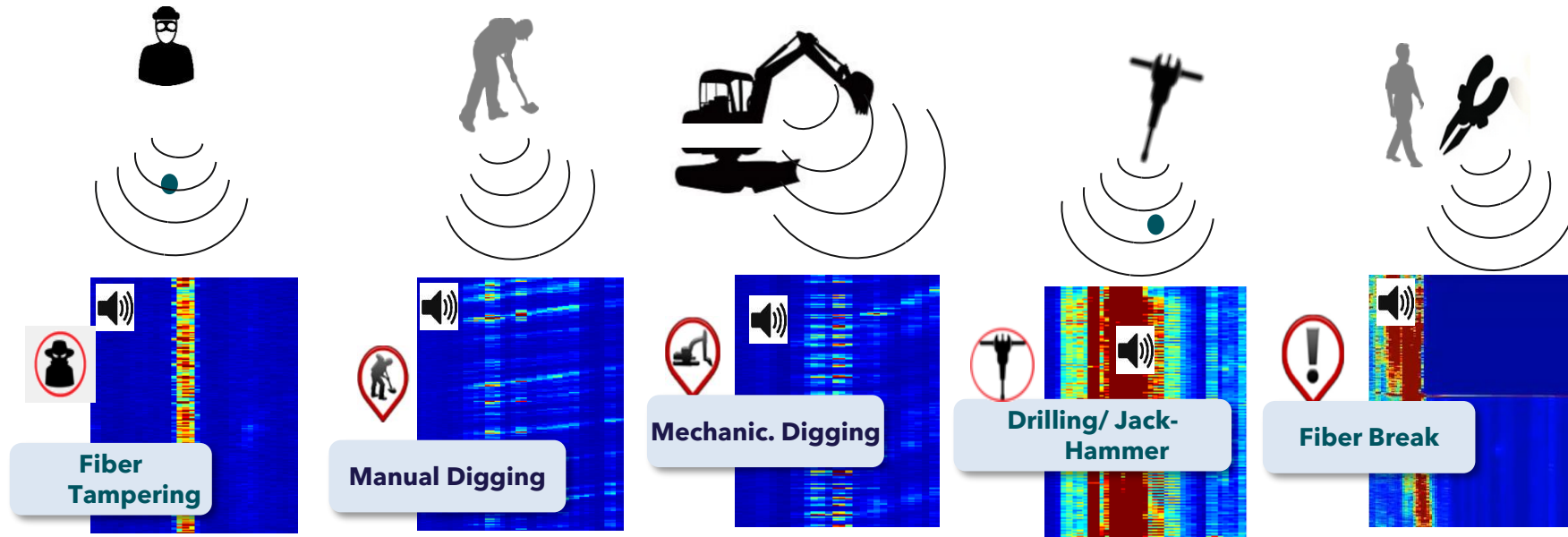
Dear Sir/Madam,

**INSTRUCTIONS ON PREVENTION OF OCCUPATIONAL HYGIENE OVER
EXPOSURES**

1. Background

DMRE instruction for real-time monitoring
of occupational hygiene overexposure

Pipeline leakage and intrusion detection



Prevention through automated detection

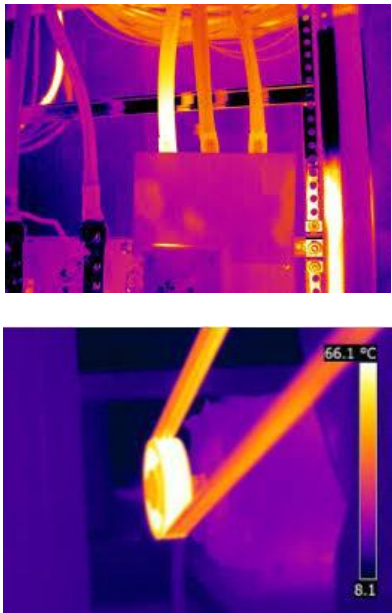


Up to 5% Increase in production

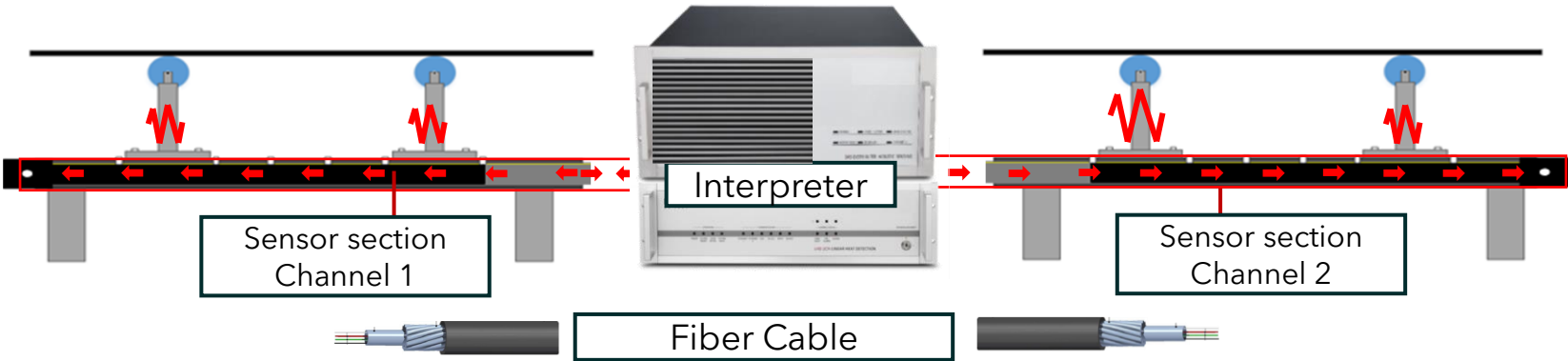
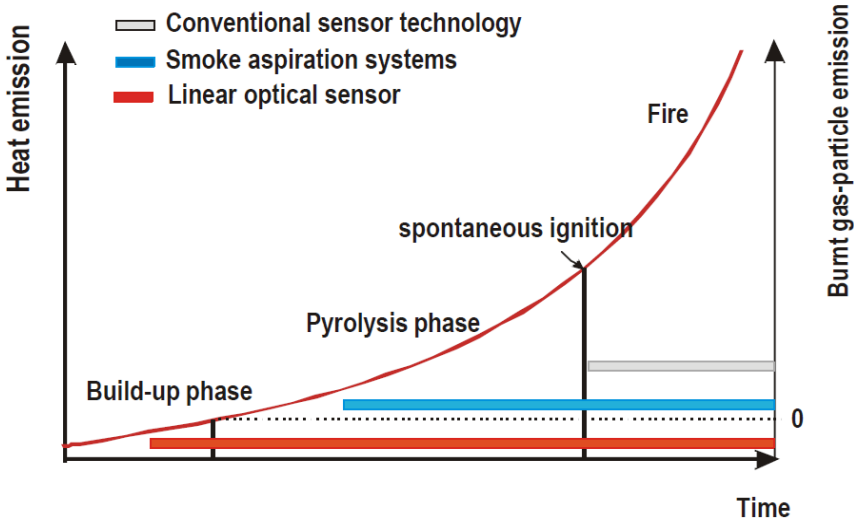
Bearing wear

- 1. Rumbling Early-stage wear
- 2. Rattling Mid-stage wear
- 3. Squeaking Mid-stage wear
- 4. Knocking Late-stage wear
- 5. Squealing Late-stage wear

OPEX ↓



Detecting fire **before** it starts along the whole asset



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Road & Rail Monitoring
Real-time position, risk and speed.

Safety and production optimisation



Conveyor Monitoring
Real-time vibration and temperature monitoring for preventative maintenance and fire detection.

Increase uptime and fire prevention



Pipeline Monitoring
Real-time leak, flow and intruder detection along the full length.

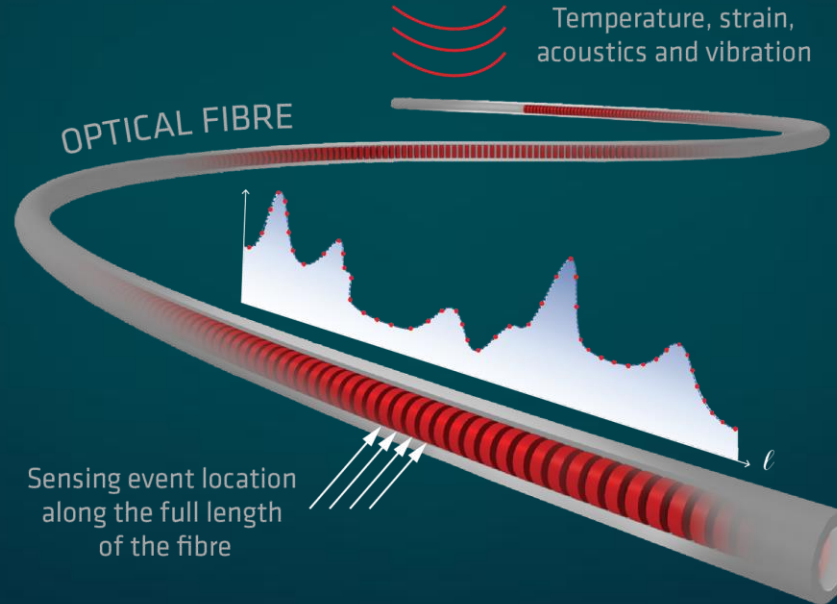
Increase uptime



Block Cave Mining
Real time rock mass monitoring using strain, temperature and seismic imaging.

Production optimisation and safety

THE FIBRE IS THE SENSOR



Demystifying DFOS
as a digital nervous system



Seismicity
Real-time monitoring of seismicity and hanging wall microstrain and movement.

Safety and Risk



Temperature, Fire and Ventilation
Real-time temperature, fire and ventilation monitoring.

Safety and Environment



Mine Security
Real-time object identification, intruder alerts and infrastructure safety.

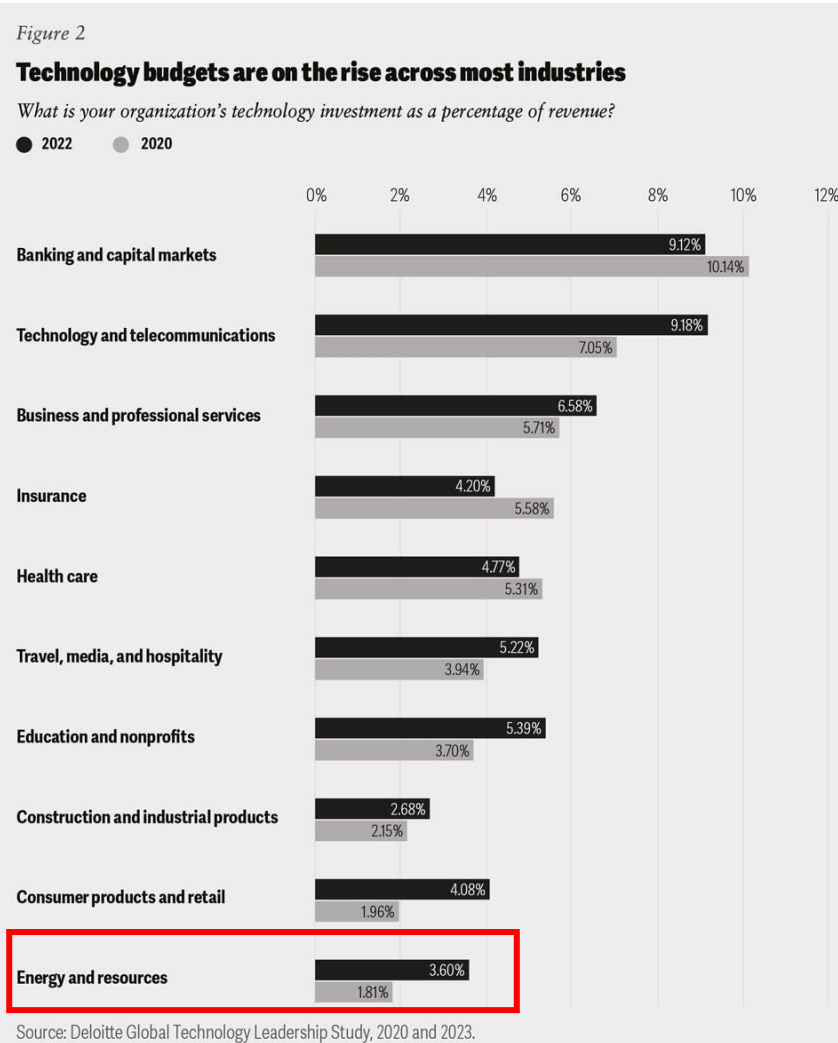
Security and Safety



Tailing Facilities
Real-time monitoring of micro-movement, phreatic surface and underground water flow.

Risk and Safety

Technology ≠ Transformation



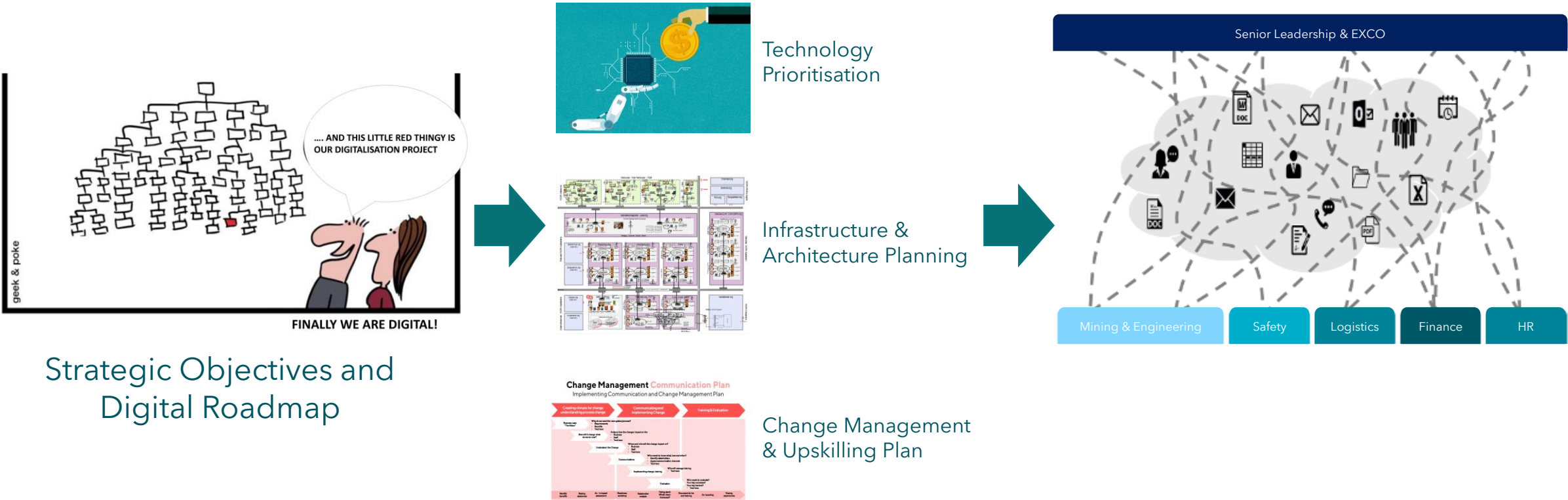
“Digital transformation could unlock USD 190 billion in value industry wide over the next 10 years.”
– World Economic Forum (2017)

Most technology initiatives are integrated into broken organizational systems and processes (operating models):

- Teams face a **flood** of **dashboards**, **alerts**, and **metrics**—but **lack clarity** on which signals to **act** on, **when**, and **how**.
- **Data** is **underused** because it takes too **long** to **collect** and **analyze** for timely decision-making.
- Poor **systems integration** and **fragmented information** limit the ability to find and focus on key system constraints.

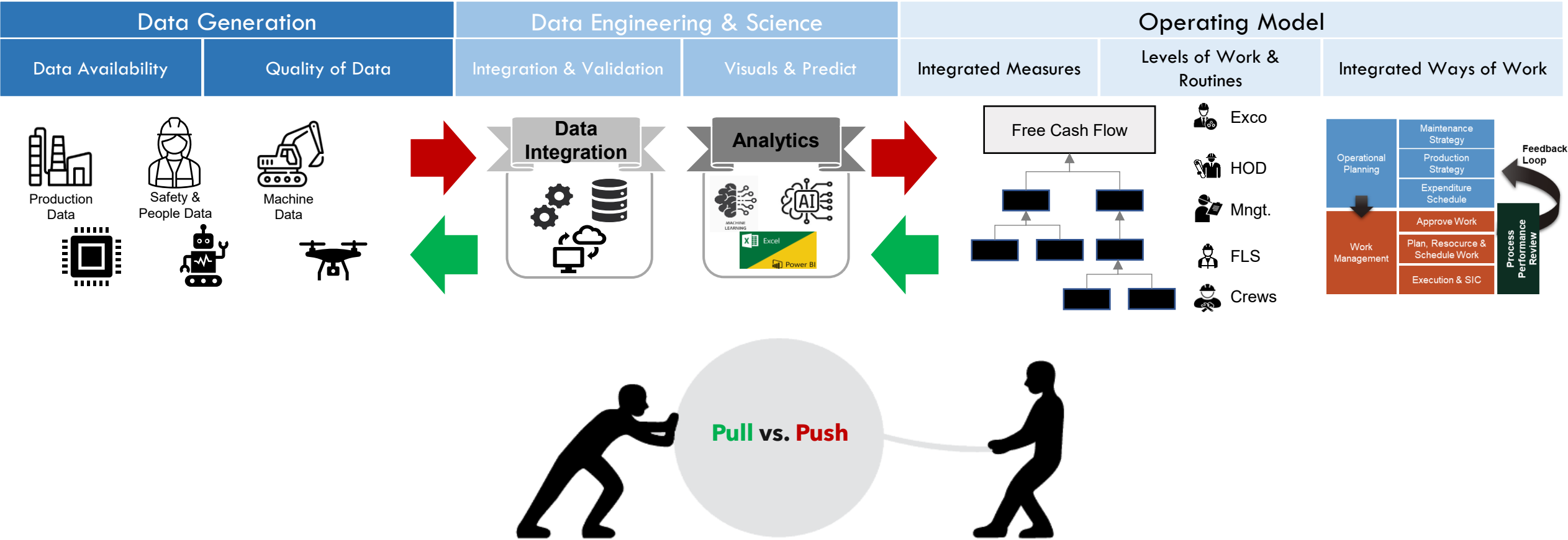
More data. Same decisions. Why?

Most digital efforts push data at people without clarity, context, or consequence—resulting in noise, not action.



Designing for Better Decisions

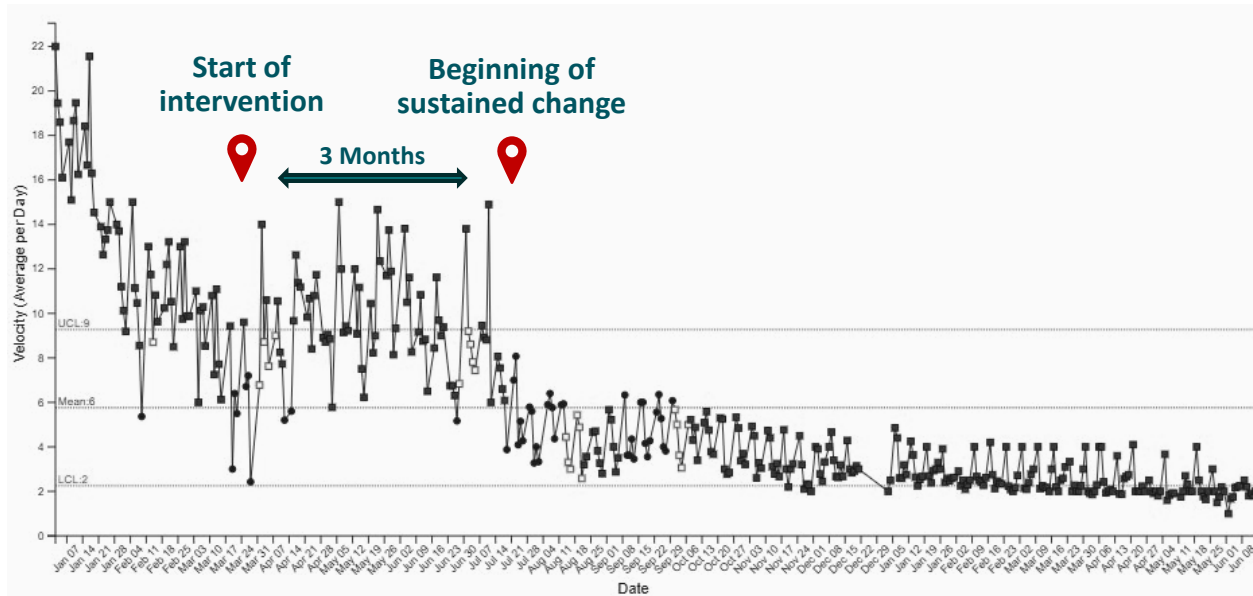
The problem isn't lack of data — it's that the operating model hasn't been evolved to absorb it effectively.



What Happens When It Works

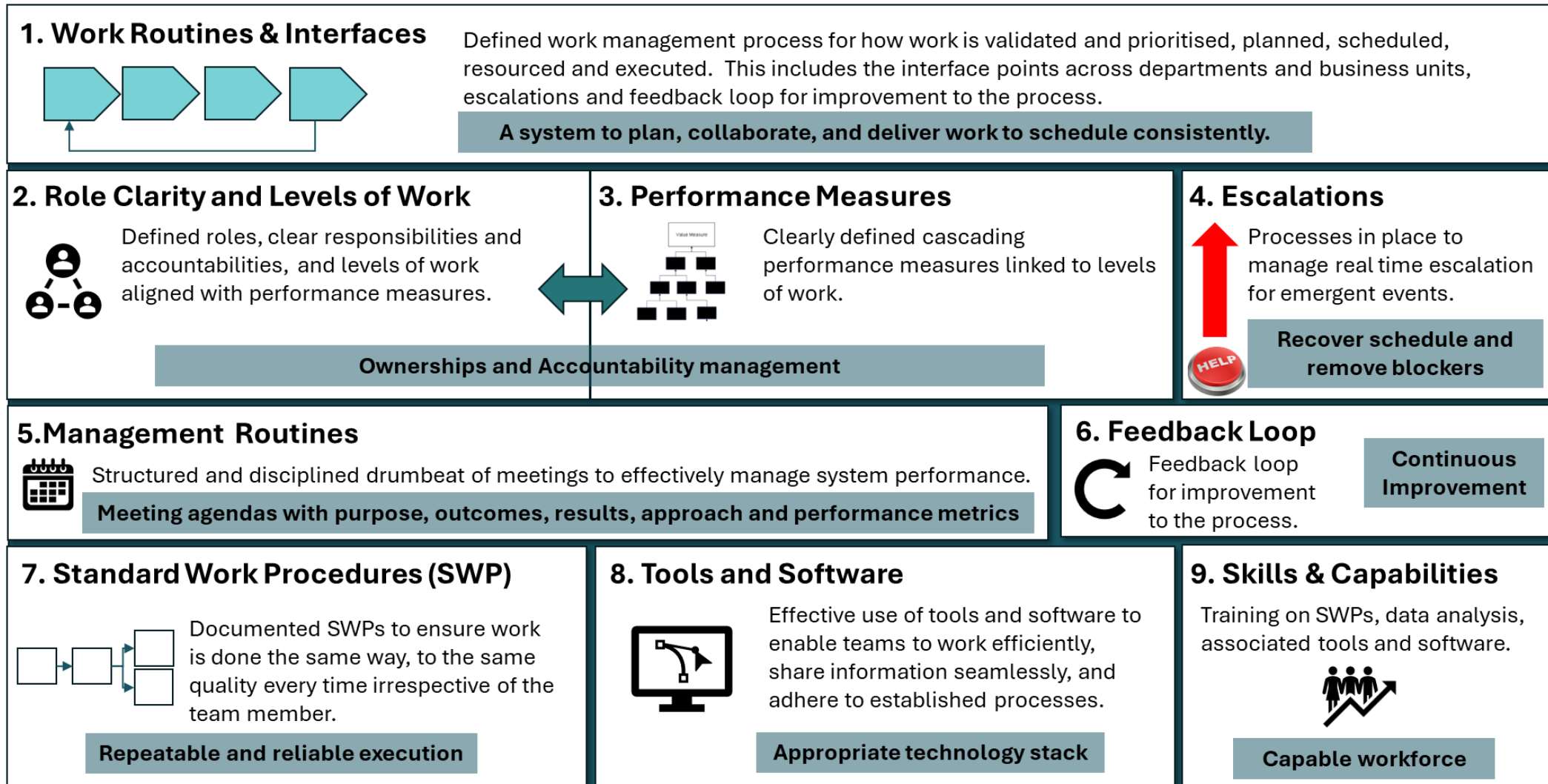
Real life case study of what happens when the right structure and routines are in place.

From **10** days total lead time to **3** days, consistently!



Technology is Only as Good as the System Around It

Digital transformation isn't just a tech upgrade — it's part of an organizational upgrade.





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