MC Mining - Vele

UNINTENDED CONSEQUENCES ON TMM OPERATORS

Ntsiky Phokwana | MOSH Transport & Machinery Team | 24 October 2025

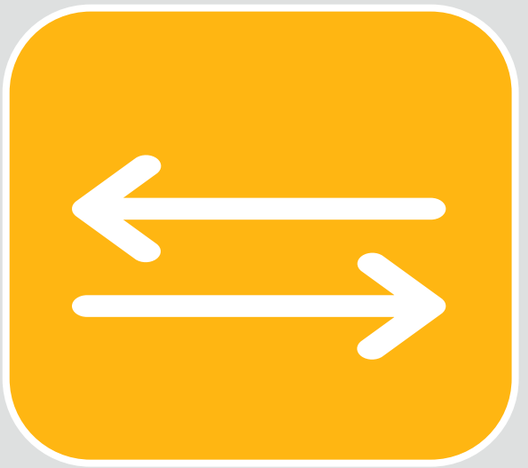
MOSH TMM CPS Symposium, Silverstar Casino, Muldersdrift

MINERALS COUNCIL
SOUTH AFRICA

Contents

1. Unintended Consequences

2. Change Management Advice



MINERALS COUNCIL SOUTH AFRICA

1. Unintended Consequences

2. Change Management Advice

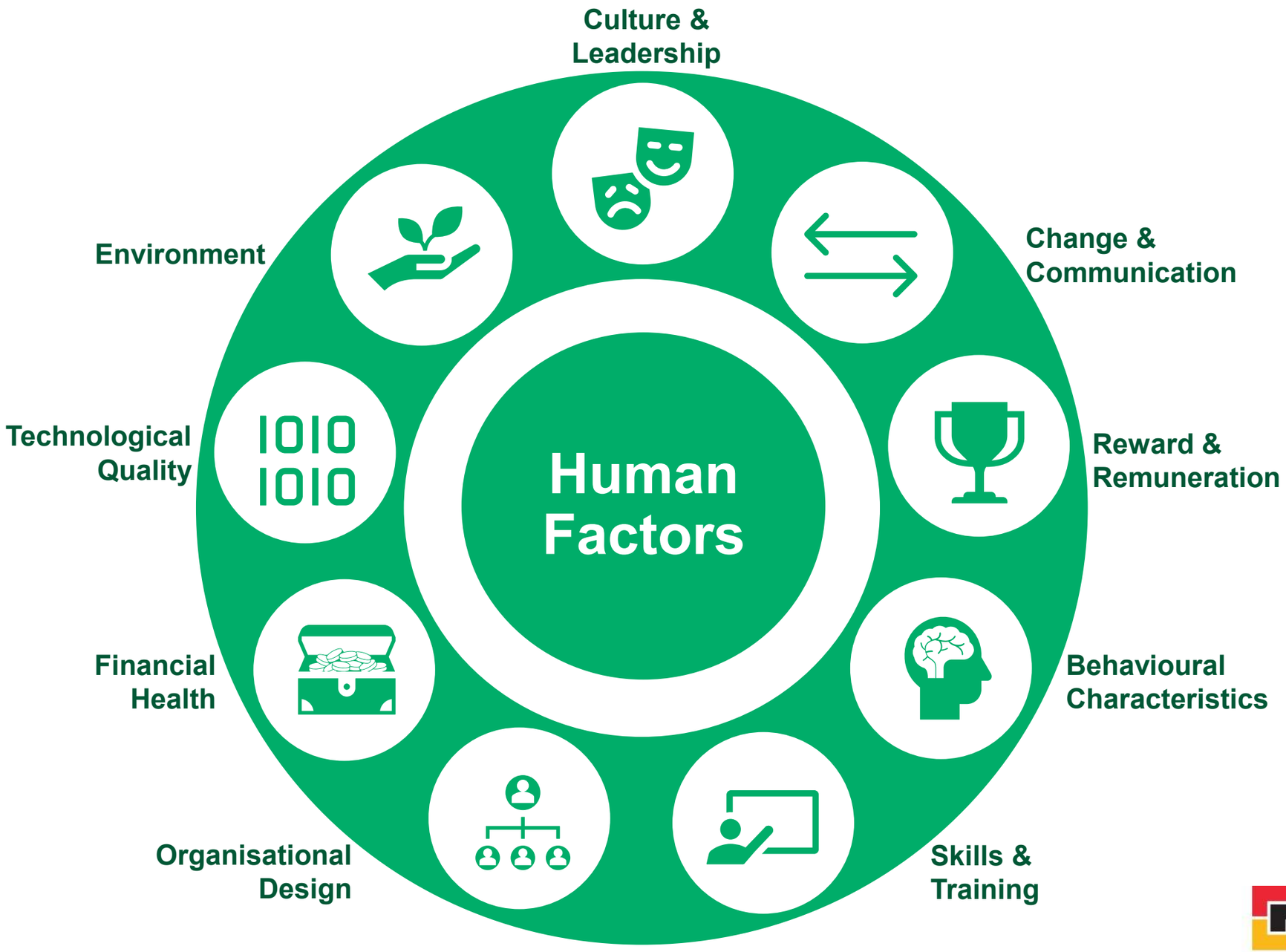
MINERALS COUNCIL SOUTH AFRICA

Project Objectives

1. Human Factors Engineering Study
2. Identify Other Operational Effects
3. Change Management Advice

MINERALS COUNCIL SOUTH AFRICA

Contextual Influences on the Human Factors



MINERALS COUNCIL SOUTH AFRICA

Human Factors Model

Internal Human Factors

- Psychological
- Cognitive
- Sensory

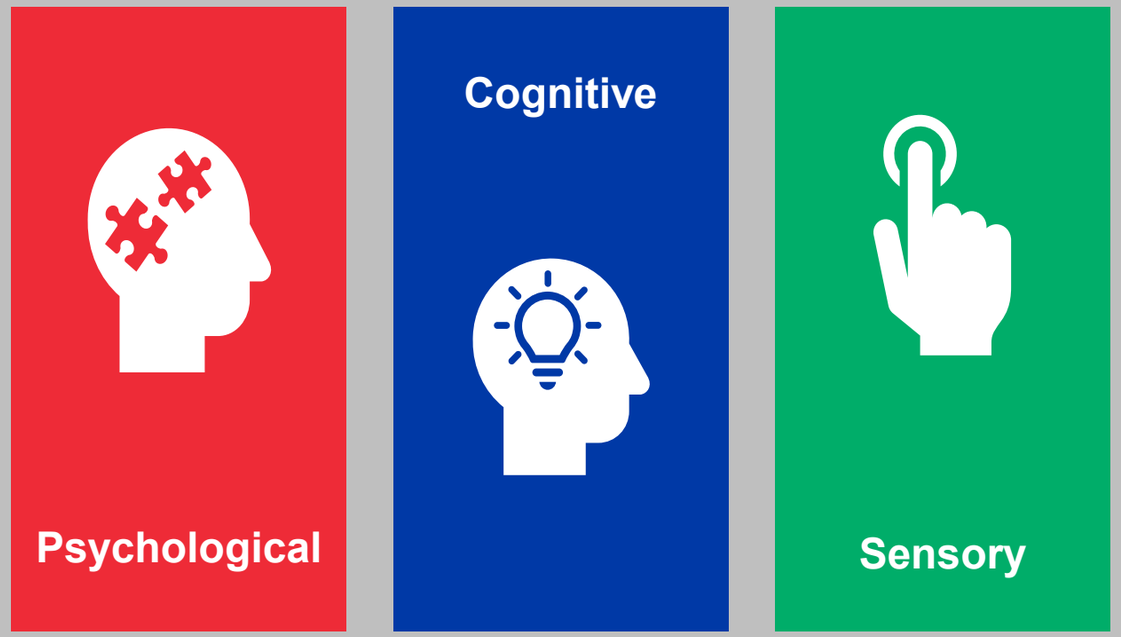
External Human Factors

- Physical
- Procedural
- Cultural

MINERALS COUNCIL SOUTH AFRICA

Human Factors Model

Internal Human Factors



MINERALS COUNCIL
SOUTH AFRICA

Psychological

PSYCHOLOGICAL (*Internal Human Factors)*

User's emotional response towards the use of a system or technology.

Risk homeostasis	Effective communication regarding the actual consequences of increased risky behaviour. Enhance the true understanding of the net benefit.
Loss of role autonomy	● Effective change management and communication - why CPS has been installed and how it will impact roles. ● Inclusion of users throughout the implementation process.
Loss of trust	● Inclusion of users throughout the implementation process. ● Only use data to enhance the effectiveness of CPS, not as a performance management tool.
Role threat	Effective change management and communication - why CPS has been installed and how it will impact roles.

Cognitive

COGNITIVE (Internal Human Factors)

One's ability to use mental action and process to understand and perceive one's environment through thought.

Cognitive overload	Minimize number of interfaces and stimuli providing info to the operator to ensure their focus is drawn to the most salient information.
Operator task error	Increased use and practice in low-risk environments.
Loss of situational awareness	Training using simulators to refresh the operator's safety-led behaviours in hazardous situations to ensure that should the CPS or PDS ever fail, they have the necessary skills and awareness to make the best decision to avoid/limit the hazardous situation.
Accident migration or task transition	Training on identifying the risks and hazards that the CPS is tasked to deal with and those risks that are not mitigated by CPS.
Over-reliance	● Communication to the operators regarding the impact and risks associated to CPS induced slow down and stop. ● Apply separation (Machines and pedestrians) principles to minimise unnecessary emergency slow down and stop occurrences. ● Train or provide awareness to pedestrians about the unintended consequence that sudden stopping has on the machine operator.
Requirement of new skills	● Ensure training is aligned to the needs of the individual and identify where more dedicated training is required. ● Implement a thorough change management and identify resistance and ensure a resistance plan is in place.
Literacy Challenges	Ensure information is communicated through images and diagrams that are universally understood.

Sensory

SENSORY (Internal Human Factors)

Information from our environment that is delivered by our senses and then how one makes sense or responds to this information.

Operator alarm fatigue	Regular and quality maintenance on the system to maintain and improve its efficacy.
Loss of visibility	Ensure alignment between the machine and technology to optimise operator visibility and the positive impact of the technology.

Human Factors Model

Internal Human Factors

Psychological

Cognitive

Sensory

External Human Factors

Physical

Procedural

Cultural

MINERALS COUNCIL SOUTH AFRICA

PHYSICAL (External Human Factors)

The impact on the human body.

Physical discomfort and/or injuries	● Communicate the potential risks to the operators and pedestrians to ensure minimisation of over-reliance issues, improved traffic management adherence and situational awareness to reduce the chance of potential collisions and therefore activation of the CPS. ● Analyse CPS data to identify areas and situations of high activation to ensure mitigation actions are established to reduce potential collisions.
Technology functional errors (e.g., stalemate)	● Advancement of technology or Installation of CPS from a single technology provider. ● The MOSH Functional and Technical Performance Requirements document has guidance on how to deal with this challenge.
Brake wear and tear	● Reduce CPS over-reliance through effective communication and proper change management. ● Communicate the potential risks to the operators and pedestrians to ensure minimisation of over-reliance issues, improved traffic management adherence and situational awareness to reduce the chance of potential collisions and therefore activation of the CPS.

Physical

PHYSICAL (External Human Factors)

The impact on the human body.

Physical

PROCEDURAL (External Human Factors)

The required process of activities and actions performed by humans.

Non-compliance due to false positives	● Dynamic calibration of systems and training aligned to the calibration of the systems will ensure that the false-positives are able to be identified and dealt with appropriately by the operator. ● The MOSH Functional and Technical Performance Requirements document has guidance on how to deal with this challenge.
Peer enforced accountability	(Positive)
Increased adherence to traffic rules	(Positive)
Procedural violations / procedural non-compliance	Increased communication and change management to ensure understanding and impact of procedural violations.

Procedural

CULTURAL (External Human Factors)

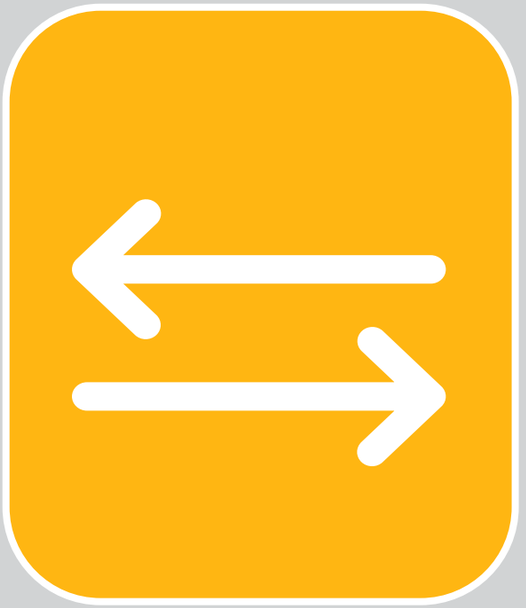
The broader ecosystem of an operational environment.

Increase in the overall safety culture	(Positive)
Sabotage – nefarious and non-nefarious	● Implementation of tamper alarms and regular health checks of systems to ensure no improper use. ● Safety behaviour-based incentives.
Assumptions of risk mitigation	Effective communication about the role of CPS and its potential impact and limitations.
Job losses due to mine closures (cannot afford to install CPS)	Implementation of controls that are higher up on the hierarchy of controls so that the risk of collision is managed to remain below significant.

Cultural

1.
Unintended
Consequences

2.
Change
Management
Advice



MINERALS COUNCIL
SOUTH AFRICA

Change Management Blueprint for Adoption of New Technologies

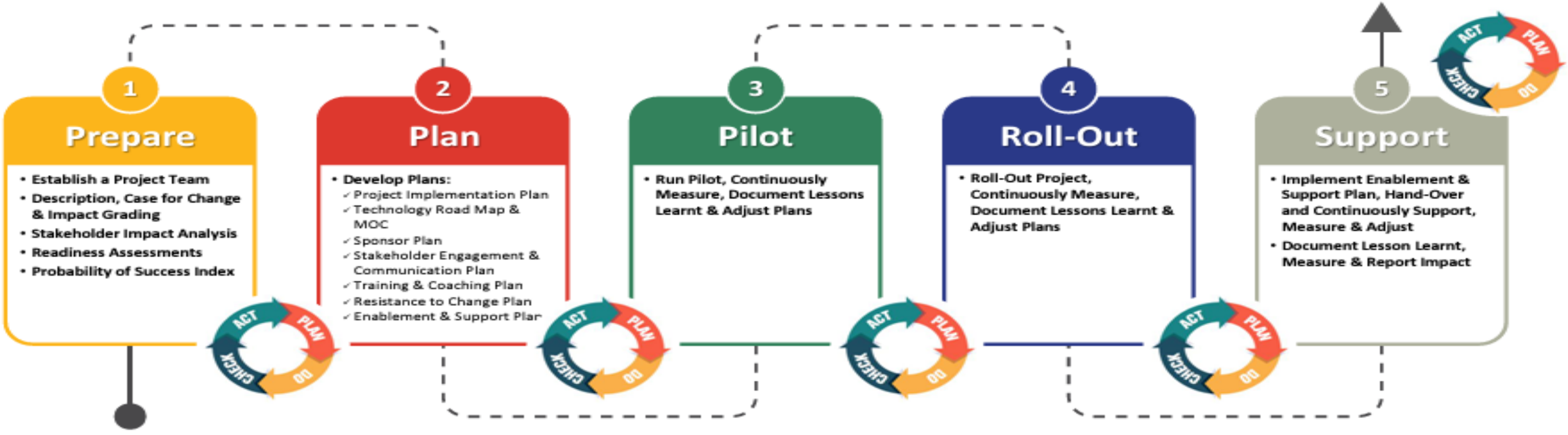
https://mandelaminingprecinct.org.za/change-management-blueprint/

MINERALS COUNCIL SOUTH AFRICA

MANDELA MINING PRECINCT
MINDS FOR MINES

3PRS CHANGE MANAGEMENT BLUEPRINT

CONTINUOUS SUPPORT
TOWARDS SUCCESSFUL CHANGE



START THE CHANGE MANAGEMENT PROCESS WITH THE FOLLOWING CRITICAL SUCCESS FACTORS AS INPUT:

i) Organisational digitisation journey / technology road map;
ii) History assessment/lessons learnt from previous digitisation projects;
iii) Current resources and/or what is already in place within the organisation for the new project.

MINERALS COUNCIL
SOUTH AFRICA

Documents

www.mosh.co.za/transport-and-machinery/documents

- Common Member Differentiated Approach & CPS Process Flow
- Interpretation of TMM Regulations
- Case study
- Good Practice Guide
- CPS Technical Documents
- CPS Skills Readiness
- CPS Unintended Consequences on Operators
- Infographic - TMM Regulations
- CPS EMI/EMC Documents

MINERALS COUNCIL SOUTH AFRICA

Anglo American Platinum – Dishaba Mine

www.mosh.co.za/transport-and-machinery/

Thank you

#MiningMatters

T +27 11 498 7100 E info@mineralscouncil.org.za W www.mineralscouncil.org.za

7th Floor Rosebank Towers, 19 Biermann Ave, Rosebank, Johannesburg, 2196

MINERALS COUNCIL
SOUTH AFRICA