MANDELA MINING PRECINCT
MINDS FOR MINES

Guideline

A best-practice evaluation matrix to assess the human readiness levels and change management for enabling modern technology and digital systems adoption in the South African mining and manufacturing industries

SATCAP2024

science & innovation
Department
Science and Innovation
REPUBLIC OF SOUTH AFRICA

CSIR

MINERALS COUNCIL
SOUTH AFRICA

MANDELA MINING PRECINCT
MINDS FOR MINES

About the Mandela Mining Precinct

The Mandela Mining Precinct is a Public-Private Partnership between the Department of Science and Innovation and the Minerals Council South Africa. The Precinct is jointly hosted by the Council for Scientific and Industrial Research and the Minerals Council. The Mandela Mining Precinct is an initiative aimed at revitalising mining research, development and innovation in South Africa to ensure the sustainability of the industry. This is achieved through the South African Mining Extraction, Research, Development and Innovation (SAMERDI) strategy.

The strategy comprises six research programmes:

1. Longevity of Current Mining;
2. Mechanised Mining Systems;
3. Advanced Orebody Knowledge;
4. Real-Time Information Management Systems;
5. **Successful Application of Technologies Centred Around People**; and
6. Test Mine.

This guideline was developed under the Successful Application of Technologies Centred Around People (SATCAP) research programme. The programme is aimed at understanding the effects, impacts and challenges of mining modernisation on people in the minerals sector. As there is a demand for a balance between people, planet and profit, SATCAP further lends support to the environmental, social and governance (ESG) agenda, with focus on the social or 'benefits to people' aspect.

SATCAP2024 Best-Practice Evaluation Matrix (HRLs and Change Application)
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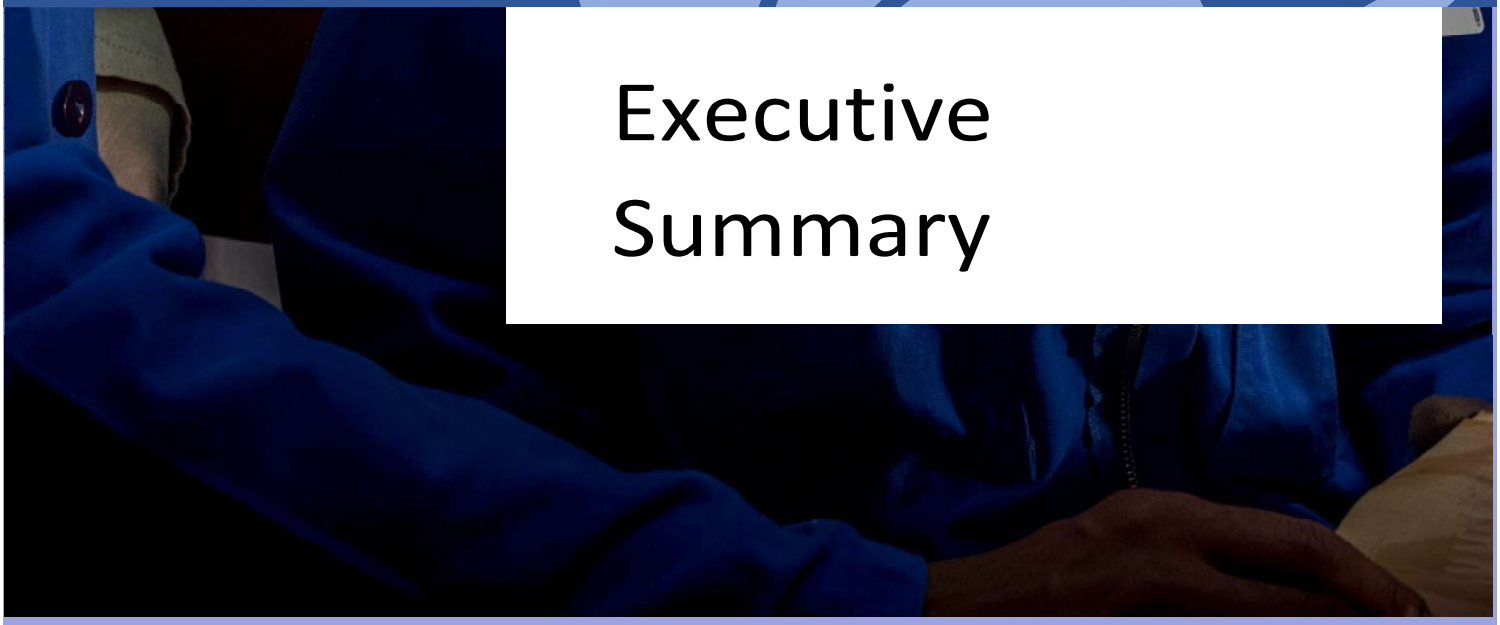
CHAPTER 1



Executive Summary

1. EXECUTIVE SUMMARY

The mining industry is confronted with escalating challenges, including declining ore grades, water scarcity, regulatory barriers, environmental concerns, and higher energy consumption associated with diminishing resource quality. Technological innovations, particularly in artificial intelligence, automation, and data analytics, present opportunities to mitigate these issues by enhancing competitiveness, profitability, and sustainability in mining operations. The Successful Application of Technology Centred Around People (SATCAP) programme aims to understand the impact of mining modernisation on stakeholders within the minerals sector, with a focus on environmental, social, and governance (ESG) aspects.

Despite advancements, mines face persistent barriers to effective technology adoption, including low technology readiness levels, insufficient capital funding, a shortage of digital skills, resistance to behavioural change, and high risks associated with untested systems. In addressing such challenges, a comprehensive approach may be required towards enabling of technology adoption and to support the ESG principles, with considering social impacts on communities and workforce dynamics. This study proposes a best-practice evaluation matrix to evaluate and enable facilitating the successful implementation of digital technologies in mining, focusing on four critical areas: technological preparedness, organisational alignment, human readiness, and change management processes. The matrix, encompassing 46 success factors, serves as a tool for identifying strengths, weaknesses, opportunities, and gaps in technology adoption, thereby allowing organisations to potentially reduce the negative impacts on people and enhancing organisational adaptability. Importantly, a people-centric and a human-centred design approach for the adoption of technologies and digital systems is critical. Further, the best-practice evaluation matrix application in evaluating change processes and human readiness levels encourages user-friendly systems, ergonomic design, and technology alignment with health and safety standards to ensure ease of adoption. Strategic alignment with organisational goals, regulatory compliance, cultural considerations, and infrastructure readiness are crucial for successful technology adoption.

Key success factors identified include strong leadership and management commitment, fostering a supportive organisational culture, transparent communication, and proactive change management. The best-practice evaluation matrix emphasises training and development, including literacy and capacity building, continuous learning opportunities, and recruitment of skilled personnel. To ensure ease of adoption, the matrix encourages user-friendly systems, ergonomic design, and technology alignment with health and safety standards. Strategic alignment with organisational goals, regulatory compliance, cultural considerations, and infrastructure readiness are also crucial for successful technology adoption.

Results from five case study assessments conducted in an international zinc mine and with Original Equipment Manufacturers (OEMs) highlight the importance of leveraging digital capabilities, user-centred design, and data integrity from the outset of the transformation process. Continuous testing and validation of systems, alongside targeted training and risk management, contribute to a secure, user-friendly digital platform. Leadership support and a culture prioritising digital adoption foster ongoing policy updates and encourage sustainable system use. Addressing skill gaps and incorporating design thinking further enhance technology acceptance and adoption within the workforce.

In conclusion, the case studies reflect that an organisation’s digital transformation journey demonstrates a balanced strategy, integrating technical capabilities, leadership engagement, and user-focused design. This holistic approach ensures alignment with strategic objectives, ESG commitments, and sustainable practices, establishing a robust foundation for digital innovation. By applying the best-practice evaluation matrix and addressing the gaps identified, mining organisations may enhance their adaptability to modern technologies, fostering long-term growth and resilience in a competitive global landscape.

CHAPTER 2

Project Aim, Research Question, and Methodology

2. PROJECT AIM, RESEARCH QUESTION AND METHODOLOGY

2.1 INTRODUCTION

The mining industry is currently encountering obstacles such as harder-to-reach lower-grade deposits, environmental and social impact concerns, health risks, and diminishing access to essential resources like water and energy. Technological advancements, including artificial intelligence, automation, and data analytics, offer potential solutions to these challenges, promising to enhance mining operations' competitiveness, profitability, and sustainability (Ediriweera & Wiewiora, 2021). As the sector modernises, systems, processes, and technologies will impact people. The Successful Application of Technology Centred Around People (SATCAP) programme, part of the South African Mining Extraction, Research, Development, and Innovation (SAMERDI) strategy led by the Mandela Mining Precinct, aims to examine the impact of mining modernisation on stakeholders within the minerals sector, with a focus on environmental, social, and governance (ESG) aspects. SATCAP prioritises a people-centric approach, ensuring that technological adoption considers human readiness, social impact, and change management to support both workforce and community well-being. A consideration of the applications of ESG, change, and Human Readiness Level (HRL) solutions in the adoption of modern technologies, with a best practice approach and success factors, was the focus of this study. This also supports the industry imperative that beyond enhancing safety and productivity, modernisation in mining may contribute to uplifting the workforce and community livelihoods while ushering in a new era of sustainable, safe, and responsible mining.

2.2 PROJECT AIM

The aim of this project was to develop a guideline consisting of case studies on a best practice approach and success factors application for:

- An ESG Impacts Dashboard, with human readiness levels (HRLs) considered; and
- Assessing HRLs and Change Management for a technology and digital system for mining modernisation.

2.3 RESEARCH QUESTION

The primary research question influencing the focus of the research is: How can mining and manufacturing organisations be enabled to adopt modern technologies and digital systems more successfully, considering the impacts on people?

To address the research question, a best practice evaluation matrix was developed to evaluate HRLs and change processes in the application of modern technologies and digital systems. Therefore, the best-practice evaluation matrix enables the user (mine/OEM) to identify:

- **The Strengths:** Clearly identify the positive organisational behaviour change activities occurring within the operation to catalyse modern technology and digital system adoption.
- **The Opportunities:** Analysis of the areas where the organisation could improve their action to unblock modern technology and digital system adoption.
- **The Risks:** The organisation can plot potential risks to modern technology and digital system adoption by analysing weaknesses and threats. These can then be mitigated by leveraging the clearly identified strengths within the organisation.
- **The Gaps:** By applying the best-practice matrix and addressing the gaps identified, mining organisations may enhance their adaptability to modern technologies, fostering long-term growth and resilience in a competitive global landscape.

2.4 METHODOLOGY

A literature review was done to obtain insights into best practice approaches, with criteria and success factors needed for the application of modern technologies. An evaluation matrix was developed with best practice criteria for the evaluation of modern mining technologies and digital system systems for human readiness, change management and ESG-relevant aspects (**see Appendix A**). For data gathering, the focus was on the identification of a technology and a digital solution(s), with partner entities, for assessment; assessing of the technology/digital system against the best

practice criteria/matrix; an analysis to determine gaps and strengths, weaknesses, opportunities and threats; and interviews with partner entities was also done to confirm a best practice approach and success factors for application of modern technologies.

The methodology entailed a four-stage empirical inquiry following Yin's (2009: 18) case study method, depicted in **Figure 1**. As such, multiple data collection methods are used in case study research, which involves an in-depth study of a phenomenon.

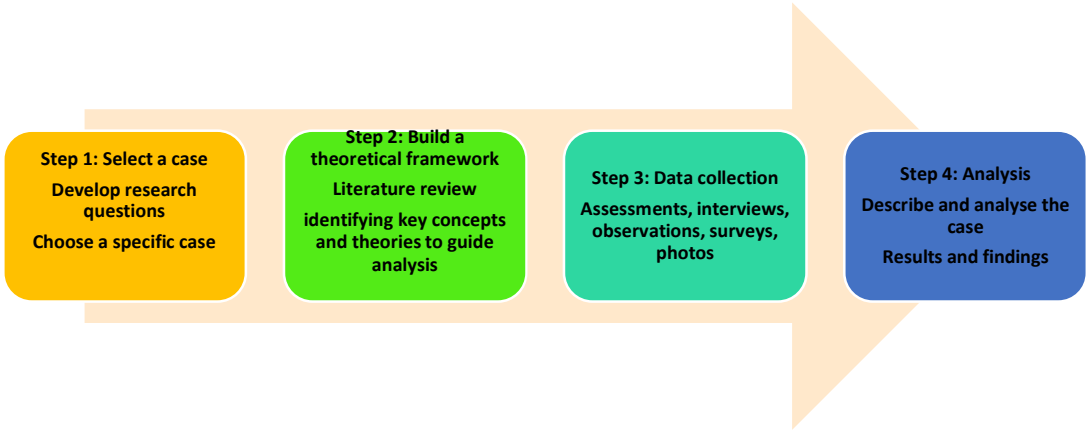


Figure 1: Applied methodology

2.4.1 CONCEPTUALISATION AND DESIGN

A best-practice evaluation matrix that considers theoretical and empirical organisational change in consideration of Human Readiness Levels for the successful adoption of modern mine and manufacturing technologies and digital systems. The best-practice evaluation matrix enables an organisation to highlight the strengths, weaknesses, opportunities and threats relating to technology and digital system adoption across four focus areas. These focus areas include:

- **Technology/Digital:** Essential technology/digital system and project-related factors which increase the success of adopting change.
- **Organisation:** Organisation's preparedness and alignment in initiating the change process to adopt modern technologies/systems.
- **Human/People:** Human factors such as training and support to increase the probability of success when implementing a change related to adopting modern technologies/systems.
- **Change Process:** People engagement, inclusion, communication, and continuous feedback to drive change and make it stick.

Further, a human-centred design approach underpins the evaluation matrix. Refer to **Appendix A** for the best-practice evaluation matrix. Human-centred design is an approach to problem-solving commonly used in process, product, service, system design, management, and engineering frameworks that involves developing solutions with human perspective at every step. Humans observe the problem within the context, brainstorm, conceptualise, develop concepts, and implement the solution (IDEO, n.d). Human-centred design is an approach to developing interactive systems that focuses on making systems usable and useful by prioritising the needs and requirements of users. It involves applying knowledge and techniques related to human factors/ergonomics and usability to enhance effectiveness and efficiency and improve human well-being, user satisfaction, accessibility, and sustainability (IDEO, n.d). Additionally, it aims to counteract any adverse effects of system use on human health, safety, and performance (**Figure 2**).

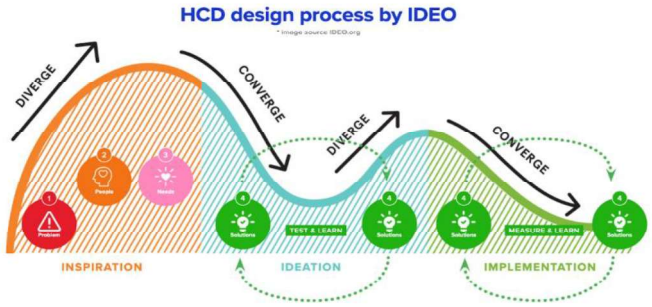


Figure 2: Human-centred design process. Source IDEO (n.d.)

2.4.2 APPLICATION OF THE BEST-PRACTICE EVALUATION MATRIX

In the application of the best-practice evaluation matrix, a series of questions focuses on the critical success factors, HRLs and change processes for adopting modern technology and/or digital systems. The comprehensiveness of the systems and processes is evaluated according to a specific assessment rating. Through critical evaluation, gaps and recommendations can be deduced which can help to inform future strategic and operational decisions to improve the adoption of technologies/digital systems.

This study used a case study methodology. Five assessments were conducted with four partner entities which included a zinc mining company that has deployed modernisation efforts, two Original Equipment Manufacturers (OEMs) working in mining and manufacturing sectors, and another OEM with strengths in ESG applications. **Table 1** describes the application of the best-practice evaluation matrix across partnering entities.

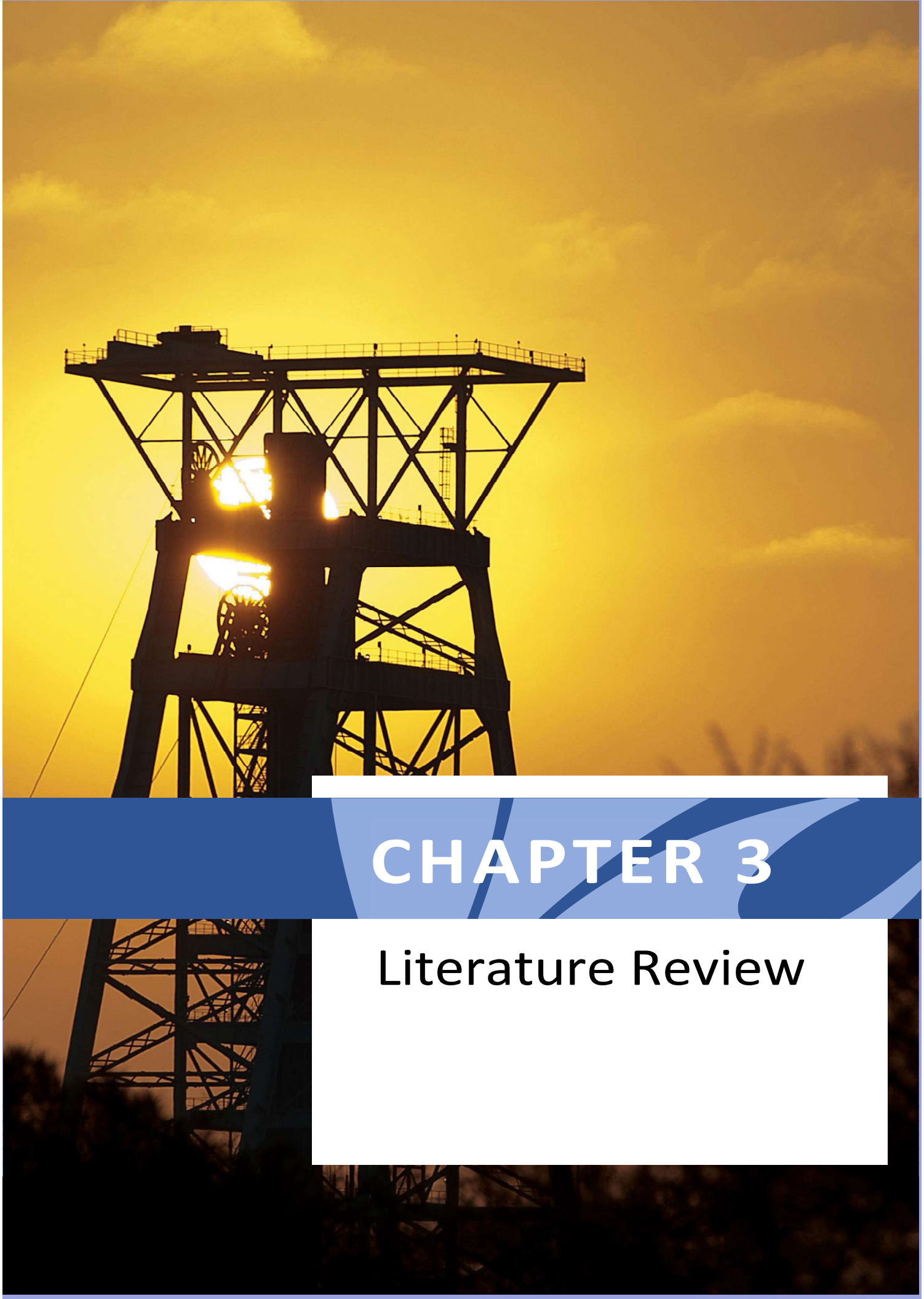
Table 1: Best-practice assessment reference table

Reference Code	Type	Technology/System	Technology/System Description	Technology/Digital System Stage of Adoption
Dashboard #1	International zinc mining house	ESG Impacts Lens Dashboard	An integrated dashboard measuring the impact of socioeconomic transformation, the impact of automation on jobs, and the effectiveness of change management practices.	Trial
Technology #1	OEM	Technology	A cloud-based task manager, schedules predictive maintenance tasks for assets and notifies technicians of breakdowns.	Adopted
System #1	OEM	System	A powerful web-based software solution enables organisations of all industries and business sectors to digitise, execute, monitor and improve their business processes remotely and securely across the entire business ecosystem.	Trial
System #2	Consulting	Digital Tools Business Case for MMP (System)	The digital "Know-More" web-based MMP platform enables the MMP to communicate valuable mining-related research and development information to the mining operational and research community.	Verification
System #3	OEM	System	Bio-metric system for employee clock-in tracking.	Adopted

A SWOT analysis was completed as per the evaluation done. The SWOT enabled the deduction of specific gaps and recommendations to enable the adoption of the technology/ digital system within the organisation, with consideration to change management practices and HRLs. The application of the best-practice evaluation matrix also enabled the understanding of the key strengths required to successfully adopt modern technology/systems and where opportunities and risks lie to further influence adoption.

2.4.3 BENEFIT FOR USING THE BEST-PRACTICE EVALUATION MATRIX

By application of the best-practice matrix and through addressing the gaps identified, mining organisations/OEMs may enhance their adaptability to modern technologies, fostering long-term growth and resilience in a competitive global landscape.



CHAPTER 3

Literature Review

3. LITERATURE REVIEW

3.1 OVERVIEW

The literature review consisted of a desktop review which focused on researching and reviewing relevant approaches to drive the adoption of modern technologies. The specific focus areas of the research included cognitive behavioural theories to support the adoption of tools, change management strategies, and effective organisational behaviour change models. Complementing the research was understanding the challenges experienced by the South African mining industry in adopting modern technologies/systems to ensure that the conceptualised evaluation matrix was built on the foundation of human-centred design. In addition, consideration was given to the following factors which needed consideration for successful adoption of technologies:

- Literacy levels, education and qualifications;
- Training and skills;
- Job profiles;
- Work systems;
- Maturity levels of mines for technology /systems adoption;
- Ergonomics;
- Health and safety;
- Infrastructure;
- Stakeholder engagement and inclusion;
- Change management;
- Workplace culture;
- Fear of job losses; and
- People readiness.

3.2 BARRIERS AND CRITICAL SUCCESS FACTORS FOR TECHNOLOGY AND DIGITAL SYSTEM ADOPTION

Research indicates that six prominent challenges exist in the mining and manufacturing industry that inhibit the adoption of technology and digital systems (Lumandi & Nyasha, 2024). These include:

- Low Technology Readiness Levels;
- A Lack of Capital Funding;
- Lack of Digital Skills;
- Behaviour/Resistance to Change;
- Technological Advancements Require Change; and
- Risk.

Empirically, significant barriers to the adoption of new technologies included resistance to change, financial constraints, and the workforce's lack of necessary skills and expertise (Amor, 2023; Senna et al., 2022). Moreover, the integration of new technologies with existing systems poses a substantial technical challenge (Amor, 2023). Organisational and systemic challenges can also impede technology adoption (Amor, 2023). Among these, negative perceptions towards technology emerge as the most influential barrier to adoption (Vimal et al., 2023). Overcoming these challenges is essential to the successful adoption of new technologies.

Despite the barriers, several critical success factors were identified which facilitate the successful adoption of new technologies and practices. Leadership and management support were found to be paramount (Hejazi, 2017). Effective communication and stakeholder engagement are also critical success factors (Stanke, 2022), and training and development play a crucial role in successful technology adoption (Lewin, 2023). Another key factor in successful technology adoption is aligning new technologies with the strategic goals of the organisation (Polanki, 2024).

3.3 THEORETICAL REVIEW OF EFFECTIVE CHANGE MANAGEMENT IN ORGANISATIONS

Successful change management in an organisational context requires considering theoretical behavioural change models to guide the planning process for dealing with the people side of change. Change management is a relatively young discipline drawing on diverse bodies of knowledge, including psychology, behavioural science, social science, organisational development, project management, process management, and neuroscience (Creasey et al., 2016: 330). This emerging discipline focuses on individuals affected by the change and how their adoption and proficient usage of the changes (may it be technology, practices, or work cycles) affect how they do their jobs. When successful, change management contributes to achieving the initiative's targeted results. The reality of failed implementation contributed to the development of various models to guide the change implementation.

The various theoretical frameworks surrounding technology adoption include:

- The **Theory of Reasoned Action (TRA)**, **Theory of Planned Behaviour (TPB)**, and **Technology Acceptance Model (TAM)**;
- The **Theory of Interpersonal Behaviour (TIB)** and **Social Cognitive Theory (SCT)**;
- The **Diffusion of Innovations Theory (DOI)** and its extension, the **Perceived Characteristics of Innovating Theory (PCIT)**;
- The **Unified Theory of Acceptance and Use of Technology (UTAUT)** and its cultural adaptation, **C-UTAUT**; and
- Other frameworks, such as **Igbaria's Model (IM)**, **Motivational Model (MM)**, **Model of PC Utilisation (MPCU)**, and **Uses and Gratification Theory (U&G)**.

The theories of technology adoption offer complementary insights into the factors driving user behaviour. A critical analysis highlights the importance of integrating these diverse perspectives to create comprehensive strategies that not only enable technology adoption but also mitigate its potential negative impacts on users. A critical similarity across these models is their shared emphasis on perceived usefulness, ease of use, and facilitating conditions as essential for technology adoption. By combining cognitive, social, and emotional considerations, organisations can foster a supportive environment that drives both initial acceptance and sustained use of new technologies.

3.4 HUMAN READINESS LEVEL CONSIDERATIONS FOR EFFECTIVE CHANGE AND ADOPTION OF MODERN TECHNOLOGY AND DIGITAL SYSTEMS

The Human Readiness Level (HRL) refers to the degree to which individuals within an organisation are prepared to accept and implement change. It is a critical factor in the successful implementation of change initiatives. The HRL scale is a simple 9-level scale used to assess, monitor, and convey a technology's readiness for safe and effective human use. It is designed after the widely recognised Technology Readiness Level (TRL) framework, aiming to offer a similar scale for readiness evaluation but with a focus on human factors (Steelman & Handley, 2022). The nine levels of the HRL scale, each representing a different stage of human readiness (Steelman & Handley, 2022) as defined in ANSI/HFES Standard 400-2021 (Human Factors and Ergonomics Society, 2021) are listed in **Table 2**. It is important to use the HRL scale as part of a broader change management strategy and adapt it as necessary to fit the specific needs and context of the organisation and the change initiative being implemented. Furthermore, it is crucial to complement it with other assessments and methods e.g., Technology Readiness Assessment (TRA), to ensure a comprehensive understanding of human readiness.

Typical key factors measured to determine the organisation's preparedness for change include assessment elements of capacity, commitment culture, leadership support, ability to adapt to change, expectations and concerns, and employee readiness (Combe, 2014; Creasey, 2023; Godard, 2022; Steelman & Handley, 2022).

Table 2: HRL scale

HRL 1:	Basic principles for human characteristics, performance, and behaviour observed and reported.
HRL 2:	Human-centred concepts, applications, and guidelines defined.
HRL 3:	Human-centred requirements to support human performance and human-technology interactions established.
HRL 4:	Modelling, part-task testing, and trade studies of human systems design concepts and applications completed.

HRL 5:	Human-centred evaluation of prototypes in mission-relevant part-task simulations completed to inform design.
HRL 6:	Human systems design fully matured as influenced by human performance analyses, metrics, prototyping, and high-fidelity simulations.
HRL 7:	Human systems design fully tested and verified in an operational environment with system hardware and software and representative users.
HRL 8:	Total human-system performance fully tested, validated, and approved in mission operations, using completed system hardware and software and representative users.
HRL 9:	System successfully used in operations across the operational envelope with systematic monitoring of human-system performance.

Adapting HRL assessments to specific industries like mining involves understanding the unique human factors and challenges within that industry. This project focuses on the human-centric aspects of advancing a developed technology or system from the demonstration phase to operational use in the mining industry. The focus is on HRL 7 to HRL 9, building upon established human-centred design principles and initial evaluations represented in HRL 1 to HRL 6. It focuses on real-world testing and human performance to evaluate technology and system adoption in a mine setup.

3.5 PEOPLE-CENTRIC APPROACH

People-centric organisational change (Change Management Insights, 2024) refers to a philosophy and approach to managing change within an organisation that primarily focuses on the people involved – the employees.
This approach recognises that the success of any change initiative, whether it involves new processes, technologies, or organisational structures, heavily depends on the people who are expected to embrace and implement these changes.

The literature (Change Management Insights, 2024) justifies the need for a people-centric approach based on its impact on employee engagement and buy-in, resistance to change, adaptability and agility, and employee well-being and satisfaction.

- **Enhances Employee Engagement and Buy-in:** Companies can greatly enhance employee engagement and commitment by including employees in the change process and addressing their needs and concerns. When employees are engaged, they are more inclined to support, advocate for, and effectively carry out the change, which increases the initiative's chances of success.
- **Reduces Resistance to Change:** Alterations frequently encounter pushback, mainly because of fear, uncertainty, or insufficient comprehension. An approach that focuses on people, prioritising transparent communication and engagement, assists in lessening these anxieties, clarifying doubts, and fostering a common understanding of the reasons and advantages of the change.
- **Improves Adaptability and Agility:** Companies that focus on their employees are more equipped to respond to external changes and challenges. A team that is involved, knowledgeable, and proficient is more flexible and able to react swiftly to new demands or changes in the marketplace.
- **Supports Employee Well-being and Satisfaction:** Acknowledging and tackling the human aspects of change shows an organization's dedication to the well-being of its employees. This approach not only aids in keeping talent but also attracts new employees, as more individuals are looking for employers who appreciate their workforce.

As per literature (Change Management Insights, 2024) key components of people-centric organisational change include:

- **Employee Involvement and Engagement:** This component emphasises actively involving employees in the change process. It is about creating channels for employees to share their ideas, concerns, and feedback, and genuinely incorporating their input into the change strategy. This approach makes employees feel valued and part of the solution.
- **Leadership Empathy and Support:** Effective leadership in people-centric change involves demonstrating empathy and providing support. Leaders need to understand the emotional and professional impact of change on employees and offer guidance and resources to help them navigate the transition.

- **Transparent and Open Communication:** This component requires maintaining clear, transparent, and continuous communication throughout the change process. It involves keeping everyone informed about what is happening, why it is happening, and how it will affect employees.
- **Training and Development Opportunities:** Providing training and development opportunities is crucial in equipping employees with the skills and knowledge needed to adapt to new ways of working. This not only aids the change process but also contributes to employee growth and job satisfaction.
- **Culture of Trust and Respect:** Building a culture that values trust, respect, and collaboration is essential in a people-centric approach. Such a culture encourages open dialogue, innovation, and a sense of community among employees.
- **Feedback and Adaptation:** A key component is continuously collecting feedback and being willing to adapt the change strategy based on this input. This shows that the organisation values employee input and is committed to making the change work for everyone.

3.6 HUMAN-CENTRED DESIGN

Further literature (Harvard Business School Online, 2020) suggests that human-centred design (HCD) is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance. HCD is an approach to design (Harvard Business School Online, 2020) that:

- Places real people at the centre of problem-solving;
- Considers stakeholders/users and their context at every phase of the design process;
- Focuses on understanding and solving the right problems;
- Recognises that everything is a complex system with interconnected parts;
- Involves the human perspective in all steps of the problem-solving process; and
- Makes feedback from the people being designed for a critical part of solution evolution.

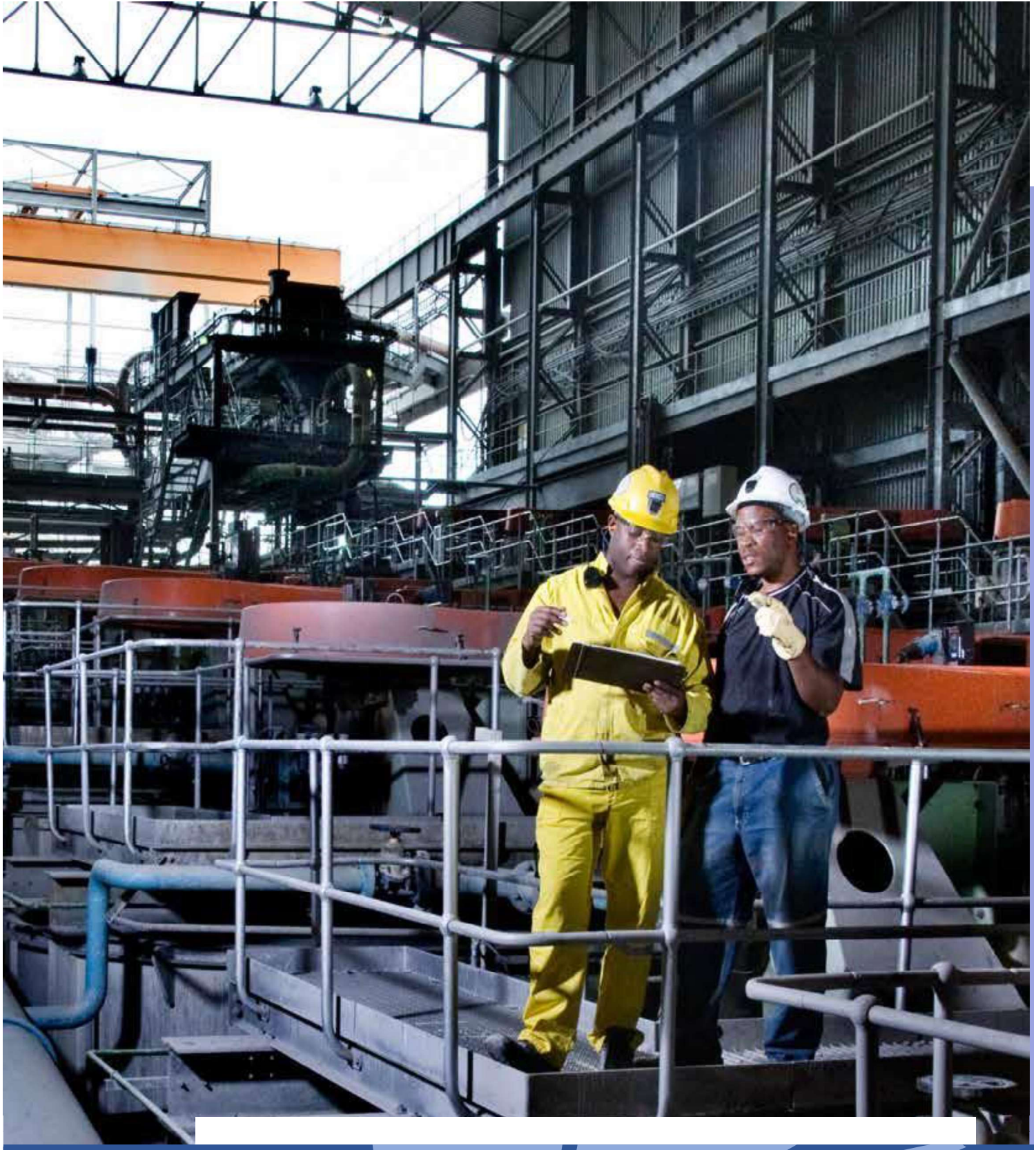
As evidenced by literature, a human-centred design and people-centric approach remains key for technology adoption.

3.7 CRITERIA FOR THE EVALUATION MATRIX

The literature review informed the development of the evaluation matrix, with best practice criteria, for evaluating of Change and HRLs applications in the adoption of modern technologies, and digital systems.

In the application of the best-practice evaluation matrix, a series of questions focuses on criteria around the critical success factors, HRLs and change processes for adopting modern technology and/or digital systems. The comprehensiveness of the systems and processes is evaluated according to identified criteria, with a specific assessment rating. Through critical evaluation, gaps and recommendations can be deduced, which can help inform future strategic and operational decisions to improve the adoption of technologies/digital systems. **Appendix A** provides for the evaluation matrix in full. A glimpse into the evaluation matrix is given below.

Focus Area:	Critical Success Factor:	Description	Criteria of Evaluation	Assessment Rating:			Recommended action to close the identified gap or change a weakness into a strength or take advantage of an opportunity to improve:
				NO (Strong Weakness/Threat)	PARTIALLY (Weakness)	YES (Strength)	
Human /People	Digital Capability Levels	Digital Capability Levels serve as a barometer for gauging the proficiency of users in handling modern technology, which is pivotal for the successful adoption of technology. The spectrum ranges from scenarios where no measures have been taken to assess digital capability, leading to potential challenges and resistance, to situations where some assessments have been conducted but are inconsistent or incomplete, necessitating further efforts to enhance user proficiency. The ideal state is when digital capability has been comprehensively evaluated, with users demonstrating proficiency and competence in effectively utilizing the new technology, thanks to thorough training.	*Have you measured the digital capability of the users of the modern technology?*	NO, digital capability has not been measured, and users' proficiency levels are not understood. There has been no training or assessment, leading to potential challenges and resistance to technology adoption.	YES, some digital capability assessments have been done but are incomplete or inconsistent. Basic training has been provided, but additional efforts are needed to fully understand and improve user proficiency.	YES, digital capability has been thoroughly measured, and users demonstrate proficiency in using modern technology. Users have received comprehensive training and consistently show competence in utilising the new technology effectively.	
	Diversity and Inclusion Adoption	Diversity and Inclusion Adoption in the context of technology implementation refers to the extent to which new technology has been tested and adopted across various job roles, skill capabilities, and experience levels. This process can range from situations where the diversity of job roles and skill capabilities are unknown and testing results are lacking, to scenarios where some testing has been conducted but does not comprehensively cover all job	*Have you tested adopting new technology across various job roles, skill capabilities, and experience?*	NO, the range of job roles and skill capabilities are unknown, and testing results are lacking.	YES, the range of job roles, skill levels, and experiences required is not certain. Some testing has been conducted, but it does not comprehensively cover all job roles, skill levels, or experiences. Results indicate varying levels of adoption.	YES, the range of job roles, skill levels, and experiences are known. Results show rightful proficiency and positive feedback, indicating inclusive and effective adoption.	



CHAPTER 4

Analysis and Findings

4. ANALYSIS AND FINDINGS

4.1 SUMMARY

Through five assessments with an international zinc mine and OEMs, the following themes were identified, which potentially enable successful modern technology and digital system adoption in practice. The study indicates that an underpinned people-centric and human-centred design approach is critical for the adoption of modern technologies and digital systems.

Figure 3: Summary of results

4.2 CASE STUDIES

The findings of SWOT analyses and specific recommendations to increase the technology adoption within the organisation are provided within this section.

4.2.1 CASE STUDY A: DASHBOARD #1

Figure 4: Dashboard #1 data analysis

The following recommendations aim to leverage core organisational strengths to address weaknesses and threats while taking advantage of opportunities to improve the adoption of an integrated dashboard measuring the impact of socioeconomic transformation, the impact of automation on jobs, and the effectiveness of change management:

- Leverage digital transformation objectives and a data-driven mindset shared by leadership to drive the organisational shift needed to adopt modern technology.
- Maintain momentum in applying the modern dashboard and communicate tangible outcomes using insights from engagements with communities to obtain comparable information and gain further support in adopting/rolling the dashboard across the organisation.
- Continue applying SATCAP digital tools (Training Needs Assessment Tool, NGO/Community Social Needs Assessment, Stakeholder and Communications Engagement Tool, Digital Leadership Competency Gap Assessment Tool, Change Management Blueprint) to gain a more comprehensive understanding of the digital skills gap across the organisation. Understand the gaps in insight generation (i.e. inductive-deductive analysis) capability to inform target training on key individuals to ensure data integrity, reliability, analysis, and accuracy.
- Include data collection and reporting engagements into the organisational monthly reporting schedule to ensure continuous data collection and analysis. Furthermore, the report consolidated insights year-on-year to emphasise the value of data collection and reporting through the SATCAP digital tools (Training Needs Assessment Tool, NGO/Community Social Needs Assessment, Stakeholder and Communications Engagement Tool, Digital Leadership Competency Gap Assessment Tool, Change Management Blueprint) and ESG Impacts Lens Dashboard.
- Report on the successes of adopting the SATCAP digital tools and compare these successes on how they alleviated challenges from previous change projects.
- Ensure leadership and management are familiar with the data analysis process of obtaining insights from the dashboard's reports and delegate key individuals to manage the capture of data from a single source.
- Continue to evaluate the applicability of SATCAP assessment questions with the digital transformation objectives to ensure data collection and analysis alignment for data-driven strategic decisions.

4.2.2 CASE STUDY B: TECHNOLOGY #1

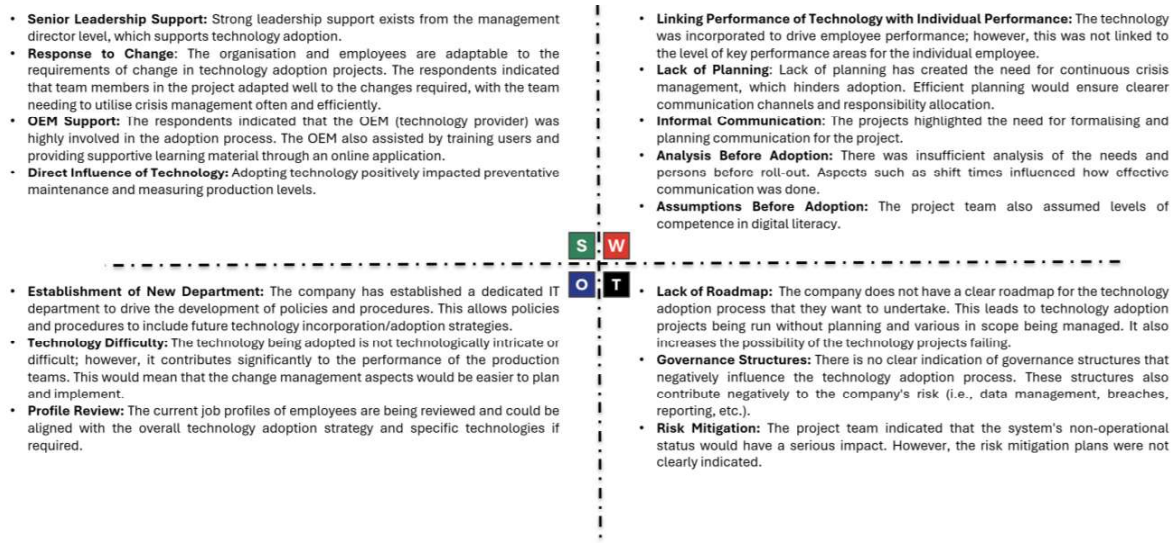


Figure 5: Technology #1 data analysis

The following recommendations apply to the adoption of a modern technology that is a cloud-based task manager schedules predictive maintenance tasks for assets and notifies technicians of breakdowns:

- Leverage senior leadership support to address the core threats to technology adoption, which relate to the lack of a digitisation roadmap, the creation of appropriate governance structures, and a clear understanding of the risks associated with technology adoption.
- The direct influence on design and development implies an opportunity to continuously refine technology with more consideration for design thinking and HRLs.

- Be clear on the weaknesses relating to technology adoption and ensure that these do not reinforce and amplify threats that already exist within technology adoption.

4 2.3 CASE STUDY C: SYSTEM #1

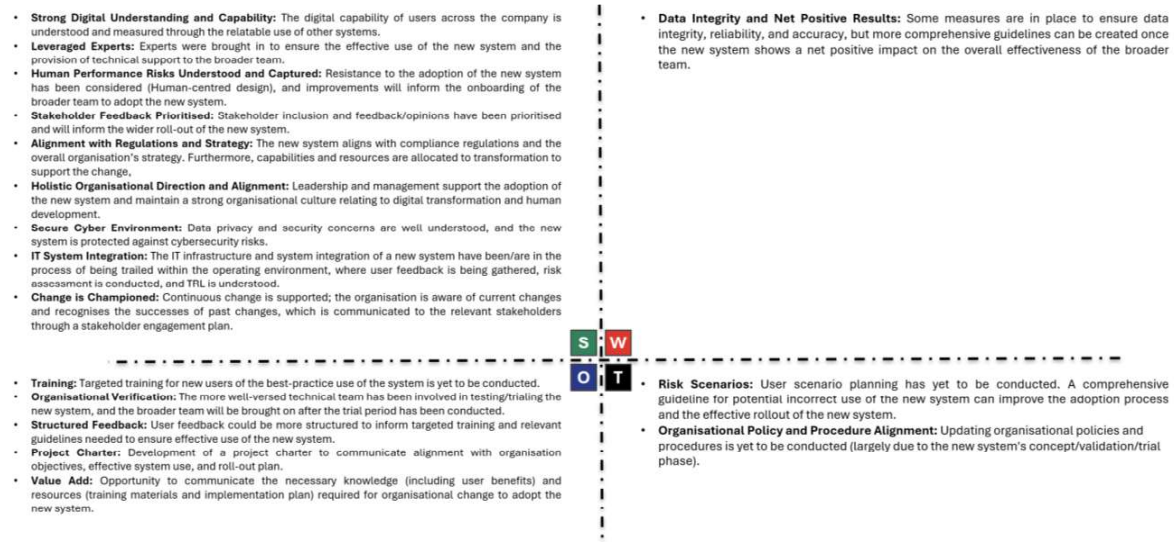


Figure 6: System #1 data analysis

The recommendations aim to leverage core organisational strengths to address weaknesses and threats while taking advantage of opportunities to improve the adoption of a powerful web-based software solution that enables organisations of all industries and business sectors to digitise, execute, monitor and improve their business processes remotely and securely across the entire business ecosystem:

- The organisation genuinely understands its digital capabilities, which is creditable to the use of relatable systems. These advanced digital skills can be utilised to establish comprehensive data integrity guidelines and ensure the effective implementation of the new system from the onset of its roll-out.
- The collective knowledge of experts, advanced technical capabilities, and, most importantly, user feedback should drive the development of a comprehensive project charter, ensuring the user experience and structured feedback are prioritised for the project's success.
- Testing and validation of the new system continued to ensure a thorough understanding of potential misuse scenarios, also known as risk scenarios, that could arise from ineffective use. These risk scenarios can be documented and utilised to inform targeted training for new users.
- Leveraging leadership and management support for continuous change should drive updating organisational policies and procedures to ensure maintained change, adoption, and effective use of the new system across the organisation.
- Leverage the organisation's culture to support digital transformation and human development. Emphasise the user benefits of adopting the new system while communicating the location of available resources to assist new users. Highlight the tangible outcomes from previous successes where new systems were implemented.

4.2.4 CASE STUDY C: SYSTEM #2

Figure 7: System #2 data analysis

The recommendations for a digital "Know-More" web-based MMP platform to enable the MMP to communicate valuable mining-related research and development information to the mining operational and research community were as follows:

- The organisation has a well-established mature life-cycle-based systems development approach in developing new platform situational awareness technologies. This mature approach can be leveraged to develop a benchmark approach towards adopting modern technologies.
- Maintain the focus and momentum on developing and completing the current partially developed adoption processes. The current systems approach to technology development provides the ideal platform to complete the formally required technology adoption practices.
- The expected growth in the situational awareness platform market will require developers to contribute a unique value to the client adoption experience. If the partially developed adoption processes can be matured, they will provide a unique total value offering to the market, not often available from developers in the information and software development sector.
- Not all future client user communities will be skilled in digital technologies; hence, more formal skills gap assessments should be performed as part of an organisation's development process. By investing in the development of adoption requirements gap analysis processes, adoption.

4.2.5 CASE STUDY D: SYSTEM #3

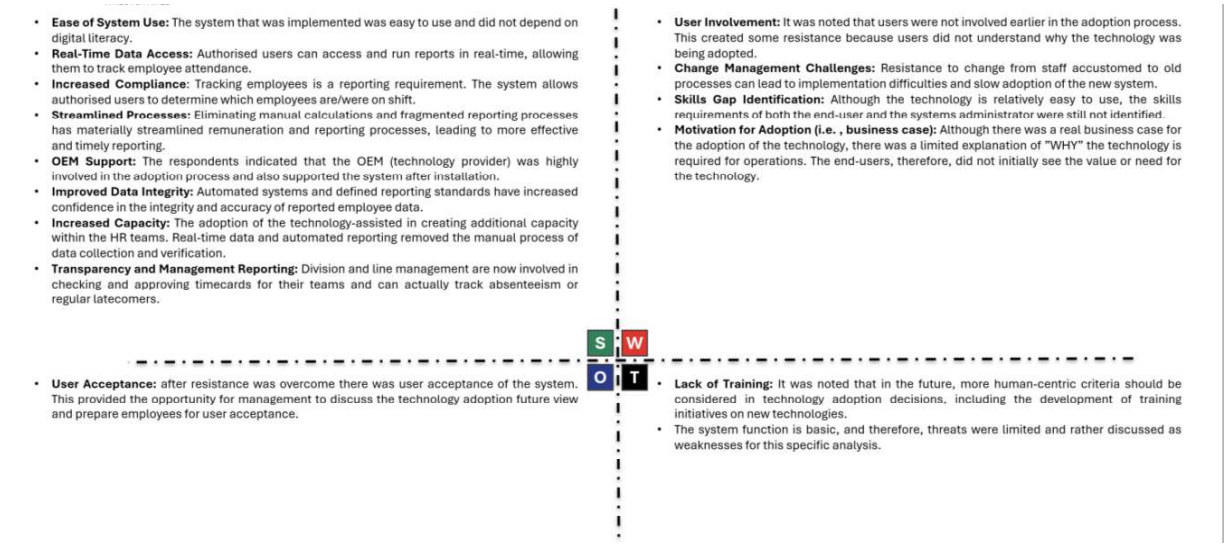
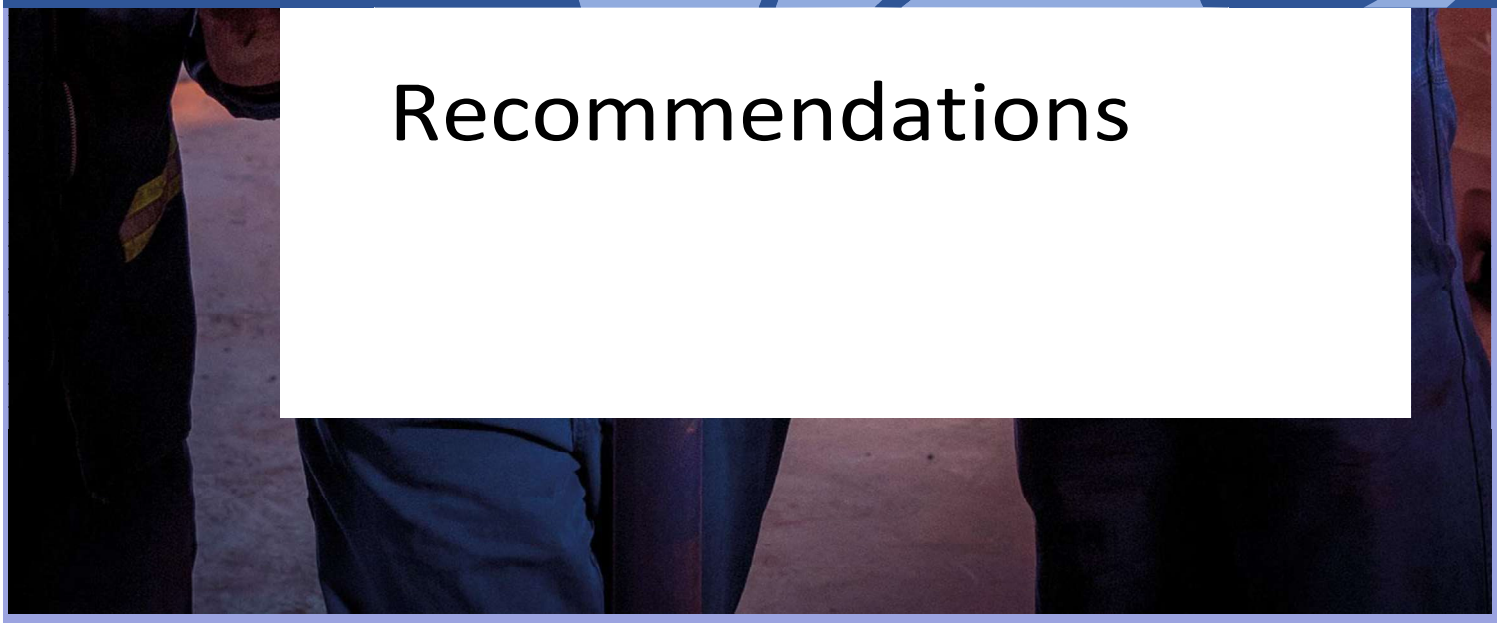


Figure 8: System #3 data analysis

The following recommendations apply to the adoption of a bio-metric system for employee clock-in tracking:

- Leverage ease of system use to drive user acceptance of the new system.
- Identify the mechanisms inhibiting effective change through the Change Management Blueprint and use the learnings to improve training for using the new system.
- Capture the tangible outcomes from adopting the new system to motivate the adoption and continued support for the new system.
- Enable the creation of structured user-feedback sessions to incorporate stakeholder feedback in improving the technology.
- Leverage OEM support and streamlined processes to regularly improve the system and train users on the effective methodology to use the new system.

CHAPTER 5



Recommendations

5. RECOMMENDATIONS

5.1 THE BEST-PRACTICE EVALUATION MATRIX

Based on the literature review, a best-practice evaluation matrix, **see Appendix A**, was developed that considers theoretical and empirical organisational change in consideration of HRLs to successfully adopt modern mining and manufacturing technologies and digital systems. The evaluation matrix was applied, for this study, to evaluate Change and HRLs application in relation to modern ESG, technologies and digital systems adoption.

The best-practice evaluation matrix enables an organisation to evaluate strengths, weaknesses, opportunities, and gaps in consideration of change practices and HRLs in relation to technology and digital system application across four focus areas. The focus areas for evaluation include:

- **Technology/Digital:** Essential technology/digital system and project-related factors which increase the success of adopting change.
- **Organisation:** Organisation's preparedness and alignment in initiating the change process to adopt modern technologies/systems.
- **Human/People:** Human factors such as training and support to increase the probability of success when implementing a change related to adopting modern technologies/systems.
- **Change Process:** People engagement, inclusion, communication, and continuous feedback to drive change and make it stick.

The best-practice evaluation matrix enables the user to identify the strengths, weaknesses, and risks (weaknesses and threats) of modern technology and digital system adoption. Refer to **Appendix A** for the complete best-practice evaluation matrix. By application of the best-practice matrix and through addressing the gaps identified, mining organisations may enhance their adaptability to modern technologies, fostering long-term growth and resilience in a competitive global landscape.

5.2 CRITICAL SUCCESS FACTORS AND BEST PRACTICE APPROACH

The evaluation matrix is underpinned by a best practice approach and critical success factors.

5.2.1 BEST PRACTICE APPROACH

The study has confirmed that a people-centric approach and human-centred design are applicable and support enabling technology adoption. Such an approach:

- **Enhances Employee Engagement and Buy-in:** When employees are engaged, they are more inclined to support, advocate for, and effectively carry out the change, which increases the initiative's chances of success.
- **Reduces Resistance to Change:** An approach that focuses on people, prioritising transparent communication and engagement, assists in lessening these anxieties, clarifying doubts, and fostering a common understanding of the reasons and advantages of the change.
- **Improves Adaptability and Agility:** Involved, knowledgeable, and proficient employees are more flexible and able to react swiftly to new demands or changes in the marketplace.
- **Supports Employee Well-being and Satisfaction:** Acknowledging and tackling the human aspects of change shows an organisation's dedication to its employees' well-being.
- **Leadership Empathy and Support:** Leaders understand the emotional and professional impact of change on employees and offer guidance and resources to workers to navigate the transition.
- **Transparent and Open Communication:** This involves keeping stakeholders informed about what is happening, why, and how it will affect employees.
- **Training and Development:** Training and development are crucial for equipping employees with the skills and knowledge needed to adapt to new ways of working.
- **Culture of Trust and Respect:** Building a culture that values trust, respect, and collaboration encourages open dialogue, innovation, and a sense of community among employees.

- **Feedback and Adaptation:** Continuously collecting feedback and being willing to adapt the change strategy based on this input shows that the organisation values employee input and is committed to making the change work for everyone.

5.2.2 CRITICAL SUCCESS FACTORS

The critical success factors to be considered for technology adoption are cited as below.

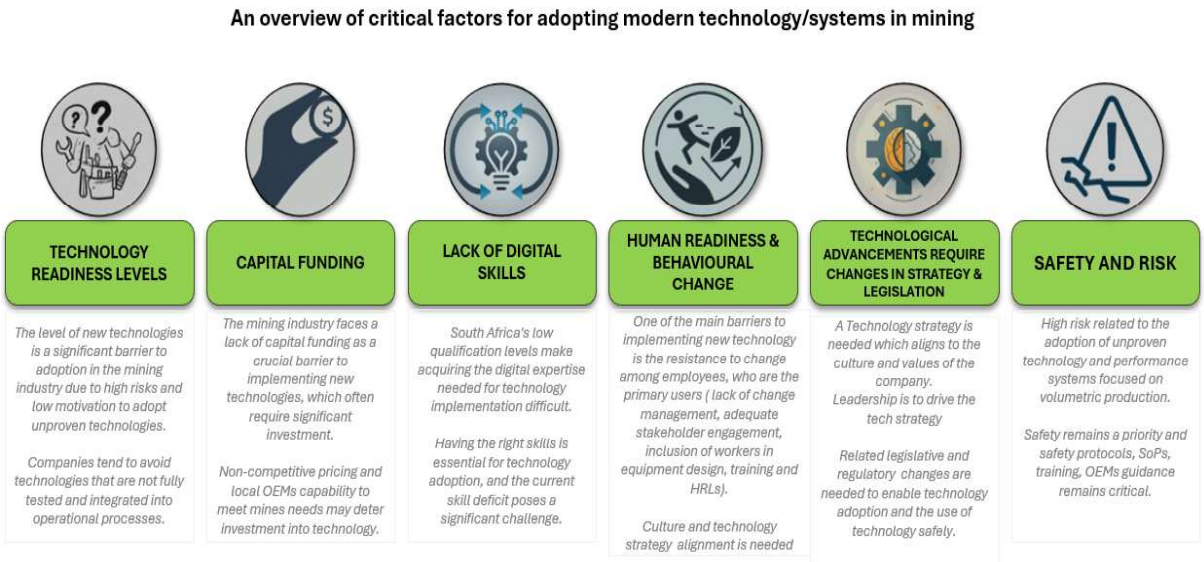


Figure 9: Critical success factors

This study confirmed the critical success factors for technology adoption. **Table 3** lists the critical success factors identified through the literature review and data analysis, which enable reducing the negative impacts of technology and digital system adoption on people while potentially increasing the overall probability of success in adoption. These critical success factors are reflected in the best-practice evaluation matrix across several evaluation criteria with specific assessment ratings.

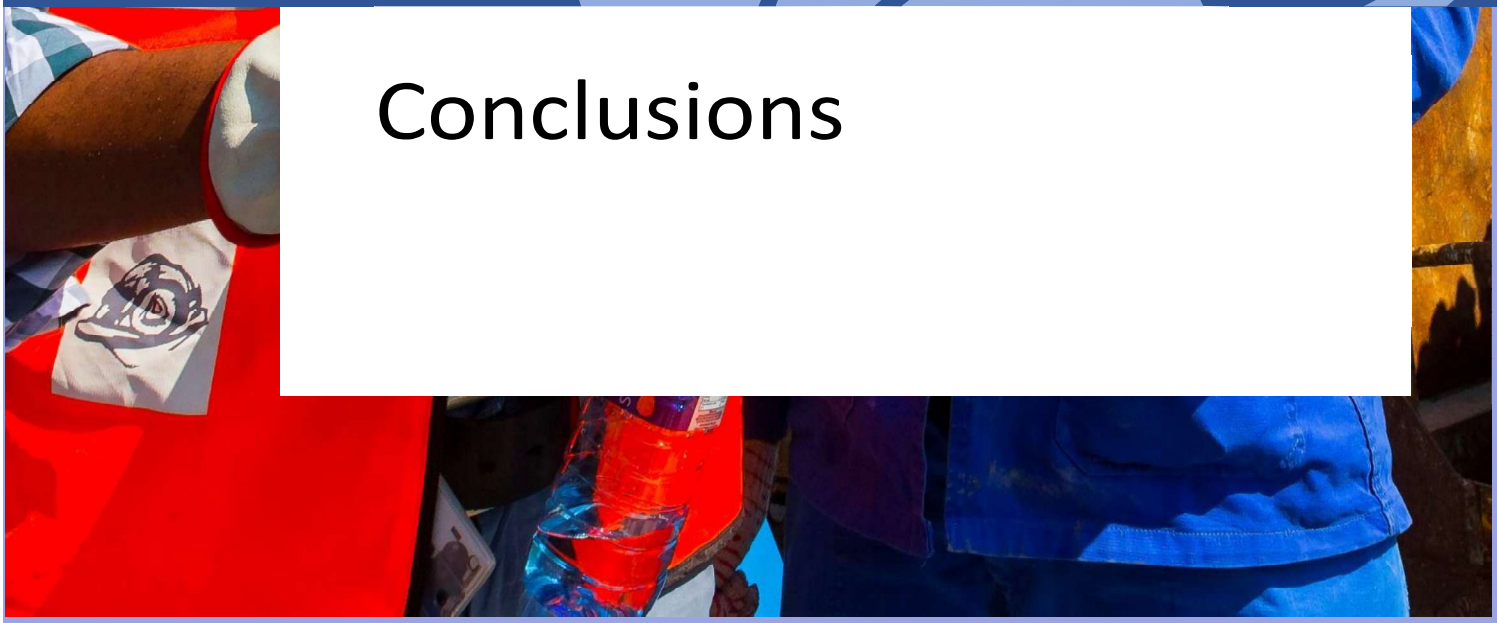
Table 3: Critical success factors for modern technology and digital system adoption

Criteria	Critical Success Factor
Social Influence and Organisational Culture	• Leadership and Management Support • Positive Organisational Culture • Technology Transformation Strategy
Effective Communication and Stakeholder Engagement and inclusion	• Transparent Communication • Change Management
Training and Development	• Literacy Levels and Digital Literacy • Capacity Development • Specialist Consultation • Continuous Learning Opportunities
Ease of Adoption and Accessibility	• User-Friendly Adoption Process • Simple Adoption Process • Health and Safety • Ergonomics
Strategic Alignment	• Alignment with Organisational Goals • Organisational Structure Review • Worker Profiles Review • Remuneration Review
Regulatory Compliance, System Integration and Data Protection	• Seamless Integration with Existing Systems • Security Considerations & Data Privacy

	• Policy and Regulation Alignment • Compliance Considerations

The study has revealed that applying the best-practice evaluation matrix has proven to provide an insightful and prescribed methodology to potentially enable organisations to improve technology adoption. The evaluation matrix applies to mining companies and OEMs, focusing on internal considerations regarding Human Readiness Levels and Change Management, which may catalyse technology adoption and improve the design of technologies/systems to better suit the users' needs.

CHAPTER 6



Conclusions

6. CONCLUSIONS

An organisation's digital transformation journey demonstrates a strategic approach to leveraging its digital capabilities, prioritising user experience, and establishing a solid foundation for long-term success. The organisation may lay the groundwork for comprehensive data integrity standards and seamless system deployment by developing a genuine understanding of its digital strengths and effectively implementing relatable systems. Employee engagement, digital literacy, and more advanced digital skills not only ensure a smoother roll-out but also allow for the management of data and technologies to be more responsible, building trust and transparency and supporting worker inclusion from the beginning of the implementation process.

A critical element in the organisation's strategy is its emphasis on collective expertise, technical capabilities, and—most importantly—user feedback. Developing a comprehensive change process within a technology project charter that includes change management remains user-centred and adaptable to real-time needs. This approach enables the organisation to continually refine its processes based on structured feedback, creating a more effective and responsive digital environment. Such emphasises the importance of the end-user experience and may contribute to higher adoption rates and satisfaction levels. Noting that a people-centric and human-centred design approach is critical for the adoption of modern technologies and digital systems.

The ongoing testing and validation of the new technology system further strengthens the transformation process by identifying potential misuse or "risk scenarios" that may arise from improper use. By documenting these scenarios, the organisation gains valuable insights that inform targeted training programmes tailored for new users, ultimately reducing the risk of errors and enhancing the system's effectiveness. This proactive approach to risk management helps the organisation anticipate and mitigate potential issues before they escalate, contributing to a more secure and reliable digital platform.

Leadership and management play an instrumental role in maintaining momentum for continuous change, supporting updates to organisational policies and procedures that facilitate system adoption and effective usage. Senior leadership's endorsement of digital transformation initiatives is crucial for driving organisational buy-in and overcoming resistance. The organisation's leadership champions the transformation and acts as a stabilising force, ensuring that the adoption of new systems aligns with strategic objectives and sustains long-term usage across all levels of the organisation.

Furthermore, to maximise the effectiveness of digital transformation, the organisation must address core threats to technology adoption, including the absence of a clear digitisation roadmap, inadequate skills development, lack of governance structures, and inadequate risk management strategies. The organisation can minimise potential barriers to successful adoption by confronting such weaknesses and fostering a resilient framework for ongoing digital innovation.

In addition, by capitalising on the user-friendly nature of the new system, the organisation may drive user acceptance and encourage widespread usage. Structured feedback sessions allow stakeholders to actively participate in improving the system, ensuring it remains responsive to evolving needs. Many organisations support and streamline processes to contribute to regular system updates and training, fostering a culture of continuous learning and improvement. By capturing tangible outcomes and success stories from prior system implementations, the organisation can further motivate users to adopt and support the new system, reinforcing the transformative impact of digitalisation on both individual and organisational levels.

Overall, the organisation's approach to digital transformation showcases a balanced strategy that combines advanced technical capabilities, leadership support, user-centred design, and robust risk management. This holistic approach not only supports current transformation goals but also lays a strong foundation for sustained growth, adaptability, and innovation in the digital era.

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APPENDIX A

BEST-PRACTICE EVALUATION MATRIX

Focus Area:	Critical Success Factor:	Description	Criteria of Evaluation	Assessment Rating:			Recommended action to close the identified gap or change a weakness into a strength or take advantage of an opportunity to improve:
				NO (Strong Weakness/Threat)	**PARTIALLY** (Weakness)	**YES** (Strength)	
Human /People	**Digital Capability Levels**	Digital Capability Levels serve as a barometer for gauging the proficiency of users in handling modern technology, which is pivotal for the successful adoption of technology. The spectrum ranges from scenarios where no measures have been taken to assess digital capability, leading to potential challenges and resistance, to situations where some assessments have been conducted but are inconsistent or incomplete, necessitating further efforts to enhance user proficiency. The ideal state is when digital capability has been comprehensively evaluated, with users demonstrating proficiency and competence in effectively utilizing the new technology, thanks to thorough training.	*Have you measured the digital capability of the users of the modern technology?*	NO, digital capability has not been measured, and users' proficiency levels are not understood. There has been no training or assessment, leading to potential challenges and resistance to technology adoption.	YES, some digital capability assessments have been done but are incomplete or inconsistent. Basic training has been provided, but additional efforts are needed to fully understand and improve user proficiency.	YES, digital capability has been thoroughly measured, and users demonstrate proficiency in using modern technology. Users have received comprehensive training and consistently show competence in utilising the new technology effectively.	
	Diversity and Inclusion Adoption	Diversity and Inclusion Adoption in the context of technology implementation refers to the extent to which new technology has been tested and adopted across various job roles, skill capabilities, and experience levels. This process can range from situations where the diversity of job roles and skill capabilities are unknown and testing results are lacking, to scenarios where some testing has been conducted but does not comprehensively cover all job roles, skill levels, or experiences, resulting in varying levels of adoption. The ideal state is when the range of job roles, skill levels, and experiences are known, and testing results show rightful proficiency and positive feedback, indicating an inclusive and effective adoption of the technology.	*Have you tested adopting new technology across various job roles, skill capabilities, and experience?*	NO, the range of job roles and skill capabilities are unknown, and testing results are lacking.	YES, the range of job roles, skill levels, and experiences required is not certain. Some testing has been conducted, but it does not comprehensively cover all job roles, skill levels, or experiences. Results indicate varying levels of adoption.	YES, the range of job roles, skill levels, and experiences are known. Results show rightful proficiency and positive feedback, indicating inclusive and effective adoption.	
	Expert Technical Support	Expert Technical Support in the context of technology implementation refers to the sourcing and recruitment of experts in modern technology to support new users	*Have you sourced and recruited experts in modern technology to*	NO efforts to utilise technology experts for support and technology adoption are showing signs of failure.	YES, experts have been identified, exist and have been used, but the support is incomplete or ineffective.	YES, technology experts have been effectively utilised, ensuring comprehensive support for	

		within an organisation. The spectrum of this process can range from situations where no efforts have been made to utilise technology experts for support, leading to signs of failure in technology adoption. In some cases, experts have been identified and used, but the support provided is incomplete or ineffective. The ideal scenario is when technology experts have been effectively utilised, providing comprehensive support for new users. This is often facilitated by a structured system that allows users to access expert help and troubleshooting, ensuring a smooth and effective technology adoption process.	*support new users within the organisation?*			new users. A structured system allows users to access expert help and troubleshooting.	
	Human-Centred Design	Human-Centred Design in the context of technology adoption refers to the consideration of users' pain points and ergonomic factors. This process can range from situations where user complaints have not been recorded or addressed, leading to discomfort or difficulty in using the technology. In some instances, user complaints have been noticed but not effectively recorded or addressed. The ideal scenario is when user complaints have been accurately recorded and comprehensively assessed within designs, resulting in user-friendly technology. This approach ensures that the technology adopted is not only efficient but also comfortable and easy to use for the users.	*Have the users' pain points and ergonomic factors been considered when adopting modern technology?*	NO, consideration of user complaints has been recorded or addressed. The technology causes discomfort or is difficult to use.	YES, user complaints have been noticed but not effectively recorded or addressed.	YES, user complaints have been accurately recorded and comprehensively assessed within designs and are user-friendly.	
	Human-Risk Performance Assessment	Human-Risk Performance Assessment in the context of technology adoption refers to the identification of potential key human performance issues and risks, and the conduction of corresponding basic research. This process can range from situations where human performance expectancies have not been defined, leading to eminent but unknown risks. In some instances, key human performance issues and risks are known, but gaps remain and are not fully understood. The ideal scenario is when key human performance criteria and targets have been defined, potential risks are clearly understood, and measures have been implemented to mitigate them. This approach ensures that the technology adopted is not only efficient but also safe and risk-free for the users.	*Have potential key human performance issues and risks been identified and concomitant basic research conducted?*	NO human performance expectancies have been defined, and risks are eminent but unknown.	YES, key human performance issues and risks are known, but gaps remain and are not fully understood.	YES, key human performance criteria and targets have been defined. Potential risks are clearly understood, and measures have been implemented to mitigate them.	
	Human Willingness to Adopt Technology	The adoption of technology by humans is significantly influenced by their psychological and cultural readiness. This readiness can range from a lack of	*Have you completed the psychological and cultural readiness assessments that*	NO consideration has been given to users' psychological and cultural readiness, resulting in	YES, there is an awareness of users' psychological and cultural importance, but it has not been recorded, is	YES, psychological and cultural readiness criteria have been identified and assessed and means to	

		consideration, which can lead to resistance or rejection of the technology, to a full understanding and accommodation of diverse psychological and cultural backgrounds. In some instances, there may be an awareness of the importance of these factors, but the assessment may not be recorded, may be incomplete or inconsistent, or may not be adequately addressed. However, when psychological and cultural readiness criteria are identified, assessed, and accommodated, the adoption of technology tends to be more successful.	*are aligned with the technology use?*	resistance, anxiety, or rejection of the new technology.	incomplete or inconsistent, and has not been adequately addressed.	accommodate diverse psychological and cultural backgrounds have been identified.	
	Skills and Training Identification	Skills and Training Identification is a critical process in technology adoption. It involves conducting a skills gap assessment to identify potential skill deficiencies. In some cases, no such assessment is conducted, leading to unidentified skill gaps. In other instances, attempts at skills gap assessment are made, but they may be incomplete or lack depth, leaving some skill deficiencies unaddressed. However, when a comprehensive skills gap assessment is conducted, all relevant skill deficiencies are identified and informs a targeted training plan.	*Have you done a skills gap assessment?*	NO skills gap assessment has been conducted, causing potential skill deficiencies.	YES, attempts at skills gap assessment have been made or have been partially made, but they are incomplete or lack depth.	YES, a comprehensive skills gap assessment has been conducted. The assessment identified all relevant skill deficiencies and informed a targeted training plan to bridge these gaps.	
	Technology-Education Capability Requirement	Technology-Education Capability Requirement relates to achieving the education requirements necessary for effectively using modern technology. In some scenarios, no education requirements are met, leading to a lack of necessary training and users being unprepared to use the technology effectively. In other cases, education requirements are set, but there are gaps, indicating the need for additional training and educational resources to fully equip users. However, in the most successful instances, all education requirements are fully met with comprehensive training programs, and users demonstrate proficiency in the required skills.	*Have the education requirements to effectively use modern technology been met?*	NO education requirements for using modern technology have been met. There is a lack of necessary training, which results in users being unprepared and unable to use the technology effectively.	YES, education requirements have been set, but there are gaps. Additional training and educational resources are needed to fully equip users with the necessary skills and knowledge.	YES, all education requirements necessary for effectively using modern technology have been fully met. Comprehensive training programs exist, and users demonstrate proficiency in the required skills.	
	Up/re/cross-skilling Provision	Up/re/cross-skilling Provision ensures the provision of targeted training and coaching for users, including reskilling programmes, upskilling initiatives, cross-skilling, and new skills training. In some situations, no such training or coaching programs are provided, leading to skill gaps and inefficiencies as users lack the necessary training to adapt to new technologies. In other cases, while such programs are provided, they may be	*Have you provided targeted training and coaching for the users, such as reskilling programmes, upskilling initiatives, cross-skilling, and new skills training?*	NO targeted training or coaching programs have been provided. Users lack the necessary training to adapt to new technologies, leading to skill gaps and inefficiencies.	YES, targeted training and coaching programs have been provided, but they are incomplete or ineffective. Additional efforts are needed to ensure all users receive comprehensive training in reskilling, upskilling, cross-skilling, and new skills.	YES, comprehensive, targeted training and coaching programs have been provided, including reskilling, upskilling, cross-skilling, and new skills training. Users have access to various training resources and demonstrate	

		incomplete or ineffective, necessitating additional efforts to ensure comprehensive training. However, in the most successful instances, comprehensive and targeted training and coaching programs are provided. Users have access to various training resources and demonstrate improved skills and competencies, indicating effective up/re/cross-skilling provision				improved skills and competencies.	
	Stakeholder Engagement	Stakeholder Engagement entails the awareness and consideration of Stakeholder feedback on adopting modern technology. In some cases, no feedback is solicited or considered, leading to potential misalignment with Stakeholder and user needs and challenges in technology adoption. In other instances, feedback is collected but may be sporadic or not systematically incorporated into the adoption process, indicating the need for additional efforts to consistently gather and utilise feedback. However, in the most successful scenarios, regular, structured stakeholder and user feedback is actively solicited and incorporated into the technology adoption process. Well-established feedback mechanisms lead to continuous improvement and user satisfaction.	*Is there user feedback on adopting modern technology?*	NO user feedback is solicited or considered. A lack of feedback leads to potential misalignment with user needs and challenges in technology adoption.	YES, user feedback is collected but sporadic or not systematically incorporated into the adoption process. Additional efforts are needed to consistently gather and utilise feedback to improve technology adoption.	YES, regular, structured user feedback is actively solicited and incorporated into the technology adoption process. Feedback mechanisms are well-established, leading to continuous improvement and user satisfaction.	
	Stakeholder Inclusion	Stakeholder Inclusion during technology adoption requires a degree of opinions and views on the utilisation and need of the technology. In some cases, these opinions and views are not collected or considered, leading to potential misalignment with user needs. In other instances, while these opinions and views are gathered, the process may be incomplete or inconsistent, indicating the need for a more systematic approach. However, in the most successful scenarios, comprehensive and diverse user opinions and adoption views are collected and used to inform decisions. This ensures that the technology meets the needs of the users and is effectively utilised, highlighting the importance of stakeholder inclusion in technology adoption.	*Have you obtained user and adoption opinions and views on the utilisation and need of the technology?*	NO, user opinions and adoption views have not been collected or considered in the decision-making process.	YES, user opinions and adoption views have been gathered, but the process may be incomplete or inconsistent.	YES, comprehensive and diverse user opinions and adoption views have been collected and used to inform decisions.	
	User-Satisfaction of Technology Adoption	User-Satisfaction of Technology Adoption is a measure of how effectively technology has enabled workers to improve their job effectiveness and safety. This can range from scenarios where technology has not led to any improvements, or there's no evidence to support such claims, to	*Has technology enabled workers to improve their job effectiveness and safety?*	NO, technology has not improved job effectiveness or safety for workers, or there is no evidence to support such claims.	YES, technology has impacted job effectiveness and safety, but the results are mixed or not fully documented.	YES, technology has clearly improved job effectiveness and safety for workers, with documented evidence of positive outcomes.	

		situations where technology has had a mixed or undocumented impact on job effectiveness and safety. However, in the most successful instances, technology has clearly improved job effectiveness and safety for workers, with documented evidence of positive outcomes. It's important to note that user satisfaction is a key indicator of successful technology adoption, reflecting the tangible benefits technology brings to the workplace					
	User-Scenario Development	User-Scenario Development Adoption refers to the process of informing users about the correct way to use technology and the behaviours associated with its use. This process can vary in effectiveness, from situations where users are not adequately informed, leading to potential misuse or misunderstanding, to scenarios where users have some awareness, but the information provided may be incomplete or inconsistent. However, in the most successful instances, users are fully informed about the correct use of technology and the associated behaviours and consequences. This ensures that users are well-prepared to use the technology effectively and responsibly, highlighting the importance of User-Scenario Development Adoption in technology adoption.	*Have the users been made aware of the consequences of the correct way to use technology and behaviours when using the technology?*	NO, users are not adequately informed about the correct use of technology or the associated behaviours and consequences.	YES, users have some awareness of the correct use and associated behaviours, but the information may be incomplete or inconsistent.	YES, users are fully informed about the correct use of technology and the associated behaviours and consequences.	
	Workplace (jobs) Impact	Workplace Impact Adoption refers to the communication of the impact of technology deployment on jobs. This can range from scenarios where there has been no effective communication, leading to potential misunderstandings or uncertainties, to situations where the impact has been communicated, but the information may be partial or not fully detailed. However, in the most successful instances, the impact of technology deployment on jobs has been clearly and thoroughly communicated to all relevant stakeholders. This ensures that everyone is aware of how technology deployment will affect their roles, leading to better preparedness and smoother transitions, highlighting the importance of Workplace Impact Adoption in technology adoption.	*Have you communicated the impact of technology deployment on jobs?*	NO, there has been no effective communication about the impact of technology deployment on jobs.	YES, the impact on jobs has been communicated, but the information may be partial or not fully detailed.	YES, the impact of technology deployment on jobs has been clearly and thoroughly communicated to all relevant stakeholders.	
Organisational	**Adherence to Compliance Regulations**	During the adoption of new technologies/systems, organisations should adhere to and ensure compliance to various regulations. These could include regulations/compliance requirements from government, the mining industry or even	*Did you update your standards to adopt/use new technology in line with compliance regulations?*	NO review was done on the organisation's compliance regulations.	YES, a review of the compliance regulations was completed, and relevant changes to standards were identified.	YES, standards have been updated to support the adoption/use of the new technology.	

		the organisation itself. The organisational standards should be updated to ensure compliance to regulations such as POPIA, Safety, etc.					
	Change in Organisational Behaviour	Refers to actioning organisational behaviour changes rather than merely planning them	*Did you modify behaviour practices in line with the adoption/use of new technology?*	NO, behaviour practices were not analysed or modified to align with technology adoption/use.	YES, behaviour practices were analysed, and a modification plan was scoped.	YES, behaviour practices were successfully modified to align with new technology adoption/use.	
	Strategy Alignment	The adoption of new technologies/systems should be aligned with the overall organisational strategy and or the organisation's digital transformation journey. A strategy should be developed, or the existing strategy should be updated to ensure alignment and then be communicated to all stakeholders to so that they all understand, accept and support the new technology/system.	*Do you have a strategy in place, or has it been updated to align with digital transformation, and has it been communicated to all stakeholders?*	NO, strategy exists to align with the digital transformation process, nor has it been communicated to all stakeholders.	YES, a strategy exists that aligns with the digital transformation process, but it has not been communicated to all stakeholders.	YES, a strategy exists that aligns with the digital transformation process, and it has been communicated to all stakeholders.	
	Internal Environmental Considerations	Refers to internal environmental considerations such as job profile and skill analysis changes rather than external environmental factors.	*Have you done a job and profile analysis for the adoption/use of the new technology?*	NO job and profile analysis were conducted.	YES, job and profile analyses were conducted, but the results were not translated into development plans.	YES, job and profile analyses were conducted, and the results informed the strategic development plans that have been implemented.	
	Inclusive Change Strategy	Broad stakeholder involvement in the development of the change strategy as well as throughout the roll-out to ensure buy-in and commitment. There is a direct correlation between stakeholder inclusiveness throughout change projects and the success of these projects.	*Have stakeholders/workforce been included in the change strategy development and roll-out?*	NO, stakeholders/workforce were not included in the change strategy development process or roll-out.	YES, stakeholders/work were included in the change strategy development process but not roll-out.	YES, stakeholders/work were included in the change strategy development and roll-out process.	
	Health and Safety Implications	It is crucial that the health and safety of all users of new technology/systems should be considered. Ensure that all considerations of the health and safety impact on users of new technology/systems have been taken and that all necessary safety protocols across the organisation are updated to integrate the new technology.	*Have you considered the health and safety impact on the technology's users and integrated the technology into safety protocols across the organisation?*	NO, the impact of health and safety on technology users has not been integrated into safety protocols across the organisation.	YES, the impact of health and safety on technology users has been integrated into safety protocols but not communicated across the organisation.	YES, the impact of health and safety on technology users has been integrated into safety protocols and communicated across the organisation.	
	Leadership and Management Support	Support from the top leadership within an organisation is a critical success factor for the adoption of new technologies/systems. If the leadership of the organisation are not committed to and support the implementation of the new technology, then the workforce lower down will also not be committed to the change.	*Do the top executives and managers support and commit to driving the technology adoption process and setting a positive tone?*	NO, the leaders and managers do not support the adoption/use of the new technology.	YES, the top executives support adopting new technology, but managers are still being onboarded.	YES, there is full support from top executives and managers to adopt/use new technology.	
	Modernisation and Digitalisation Governance	Whenever new technologies/systems are implemented, it is important to develop and/or revise existing policies and procedures that might be affected by the implementation of the new technology. The users of the new technology must know and understand how their daily work/activities	*Have you updated and communicated the policies and procedures for implementing the new technology and how these will have an impact on the technology's users?*	NO review was done on the organisation's policies and procedures.	YES, but the assessment did not cover all necessary policies and procedures.	YES, a detailed review was done on policies and procedures that will be necessary/affected.	

		will be impacted through the use of the new technology.					
	Positive Organisation Culture focused on Human Development	Organisations with a positive organisational culture towards human development when implementing new technologies/systems are more successful. If the organisation's culture supports digital transformation, then people tend to support the implementation of new technologies/systems, and the adoption rate is quicker.	*Does the culture support the digital transformation strategy?*	NO, the organisational culture does not support digital transformation.	YES, the digital transformation strategy exists and focuses on human development, but work is needed to align it with the organisational culture.	YES, the organisational culture supports a positive sentiment towards digital transformation and human development.	
	Privacy and Data Security Concerns	It is crucial for the organisation to put effective measures in place to manage and ensure data privacy and cybersecurity concerns are met. In addition, every time new technologies/systems are implemented, organisations must review their data privacy and cybersecurity mechanisms to ensure that it will support the new technology and/or that they are still effective.	*Do you have data privacy and cybersecurity mechanisms in place to support new technology adoption/use?*	NO, the organisation does not have data privacy and cybersecurity mechanisms to support the adoption/use of new technology.	YES, the organisation has data privacy and cybersecurity mechanisms, but these are outdated and do not align with new technology requirements.	YES, the organisation has data privacy and cybersecurity mechanisms to support the adoption/use of new technology.	
	Re-alignment of Organisational Structures	Structure follows strategy. A review of the organisational structure should be done every time the strategy changes to ensure that the structures can deliver on adopting or using modern technologies.	*Have you re-aligned the organisational structures to deliver on adopting/using modern technology?*	NO, the organisation has not re-aligned to deliver on adopting/using modern technology.	YES, the organisation is aware of the re-alignment necessary to deliver on adopting/using modern technology, but implementation is in progress.	YES, the organisation has re-aligned to deliver on adopting/using modern technology.	
	Re-alignment of Workforce Profiles & Remuneration	When new technologies/systems are implemented, it will have a subsequent impact or changes to the users' job profiles and remuneration. During the implementation process an evaluation and review should be done to re-align the workforce profiles and worker remuneration with the newly updated/changed requirements.	*Have you re-aligned the workforce profiles and worker remuneration to deliver on adopting/using modern technology?*	NO, the organisation is unaware of the workforce profile and worker remuneration re-alignment necessary to support the adoption/use of modern technology.	YES, the organisation has a plan to re-align workforce profiles and worker remuneration necessary to support the adoption/use of modern technology, but implementation is pending.	YES, the organisation has re-aligned the workforce profiles and worker remuneration to deliver on adopting/using modern technology successfully.	
	Value-Add for Adoption	Successful modernisation projects have clearly stated benefits or value proposition for all stakeholders. Adoption of the new technology/system will be quicker if all stakeholders know "what's in it for them".	*Does the organisation have a value proposition that benefits all stakeholders for technology adoption?*	NO, the organisation does not have a value proposition for adopting modern technology that benefits all stakeholders.	YES, a value proposition for adopting modern technology exists, but it does not yet benefit all stakeholders.	YES, the organisation has a value proposition for adopting modern technology that benefits all stakeholders.	
Technology / Digital Systems	**Data Integrity**	Data integrity refers to the accuracy, completeness, and quality of data accumulated. Data integrity enhances user confidence and the likelihood of new tech adoption. Human error, inconsistencies across different formats, collection errors and cybersecurity breaches are all threats to data integrity.	*Do you have protocols for the correct data-capturing practices to maintain data integrity, and have you trained users?*	NO measures are taken to ensure reliable and accurate information.	YES, some measures are in place to ensure reliability and accuracy, but they do not cover all aspects, and training has not occurred.	YES, detailed measures are in place to ensure reliability and accurate input and output information that is supported by active training.	
	IT Infrastructure and Systems	The dashboard/new technology will need to be integrated with existing I.T. infrastructure and will also need to comply with relevant regulatory standards. It is important to review legacy systems and	*Have you considered the IT infrastructure and systems architecture for ease of user adoption?*	NO review was done on the existing IT infrastructure and systems.	YES, but the assessment did not cover all infrastructure and considerations.	YES, a detailed review of the existing IT infrastructure and systems was done.	

		ensure compatibility of new technology with existing systems, and to implement measures to protect data during the integration process.					
	Key Performance Indicators for Effective Use	Key Performance Indicators (KPIs) are specific, measurable, achievable, relevant, time-bound metrics that are used to track an organisation's progress toward its goals. KPIs are important for directing the organisation's modernisation strategy, as well as tracking progress and alignment with strategic goals.	*Have you developed Key Performance Indicators (KPIs) to measure users' adoption and the effectiveness of their adoption?*	NO KPIs were identified.	YES, but only some KPIs are included, or some are not measurable.	YES, all relevant KPIs were identified and stated in measurable terms.	
	Organisational digitisation journey/technology roadmap	Ensuring there is a technology adoption roadmap which indicates the process, people, and organisation changes needed to ensure successful adoption of the new technology/system.	*Have you inclusively developed an organisation digitisation roadmap to roll out the new technology?*	NO, there is no alignment between this specific technology and the organisational strategy.	YES, some alignment exists, but it does not fully link the technology to the organisation's objectives or roll-out plan.	YES, the technology is directly aligned with the organisational strategy and has been rolled out.	
	Simulation of Technology in Operating Environment	Ensuring testing the technology/system in the operating environment from multiple different user-cases (i.e. from the best users to more laggard adopters).	*Have you piloted or simulated the use of the technology in the operating environment to consider user inputs?*	NO, the technology has not yet been piloted or simulated.	YES, a plan exists to pilot the technology in the operating environment.	YES, the technology has been piloted, and user feedback has been captured and considered.	
	Technology Attainment Goals	Aligning the technology adoption objectives with the overall benefit/value for the organisation.	*Does the technology use meet or contribute to attaining improved safety, production, and sustainability goals?*	NO, the technology does not meet or contribute to attaining improved safety, production, and sustainability goals.	YES, adopting modern technology has desired objectives, but these need to be aligned to collectively improve safety, production, and sustainability.	YES, the technology meets and contributes to attaining improved safety, production, and sustainability goals.	
	Technology Adoption Risk Assessment	Upgrading or enhancing digital systems is a complex process, and can carry risks from a business, operational and security perspective. Risks can be mitigated through adequate planning.	*Have you performed the required risk assessment and implemented mitigation/contingency plans to address risks?*	NO risk assessment was performed.	YES, a risk assessment was completed, but mitigation/contingency plans are still being finalised.	YES, a risk assessment was completed with detailed mitigation/contingency plans.	
	New Technology/System Readiness	Reference to the Technology Readiness Assessment evaluation and whether the organisation understands the TRL that the new technology/system applies to.	*Have you done a Technology Readiness Assessment on the new technology to be implemented?*	NO, the technology to be implemented is not ready yet (TRL3 and below).	YES, but some aspects are still not ready (TRL4).	YES, the technology is ready to be piloted and implemented (TRL5 and above).	
	Technology Systems Integration	The dashboard/new technology will need to be integrated with existing I.T. infrastructure and will also need to comply with all relevant regulatory standards. Changes may need to be made to existing I.T. infrastructure to ensure dashboard compatibility.	*Have you implemented the required in-house IT changes or systems integration protocols and infrastructure to adopt/use the new technology?*	NO, IT changes or system integration protocols have been developed.	YES, IT changes and system integration protocols have been developed but have not been rolled out.	YES, IT change and system integration protocols are established and running.	
Change Process	**Continuous Awareness of Change**	To ensure holistic alignment along the change journey, detailed awareness of the change management process and expected responsibilities is required across those who are involved in the changes.	*Have you created awareness around the need for the change?*	NO awareness of change has been created.	YES, there is evidence of change, but it has not been communicated to the organisation.	YES, full awareness of change across the operation.	
	Knowledge of Change	Expanding on building awareness of change, are there reflective documents or content that easily communicates the change	*Have you provided the necessary knowledge and skills development to support change?*	NO knowledge and skill development has taken place.	YES, there are knowledge and skill development plans, but they have not yet been implemented.	YES, knowledge and skills transfer has occurred across the operation.	

		process and training guides to support the change.					
	Resources for Change	From an operational perspective, has the organisation matches resources with capabilities to enable change.	*Have you provided the technology tools and systems for applying the change?*	NO tools and systems are in place to support the change	YES, tools and systems exist but have not been shared with relevant individuals.	YES, tools and systems exist and are being utilised across the organisation.	
	Recognition of Change	Change is a continuous process of learning, has the organisation captured previous change management projects and celebrated the successes from those processes.	*Do you celebrate the successes of change and acknowledge the small wins and incremental efforts from changing?*	NO, there is no evidence collating the successes of the change.	YES, there is evidence of the successes of change, but we are not collectively celebrating them.	YES, all successes are celebrated and praised across the organisation.	
	User Adoption Benefits	From an organisational behaviour perspective, users will align with changes if the benefits outweigh the effort to do something different.	*Does the adoption benefit the users in terms of improved safety, production, and ease of task completion?*	NO, the technology has zero benefits for the user.	YES, the technology benefits the users, but these have not been communicated to the relevant stakeholders.	YES, the technology benefits the users and has been communicated to the relevant stakeholders.	
	Historical Recall of Lessons	Focusing on reflecting on past successes and failure points of previous change processes to ensure calibration for future projects.	*Have you reviewed the lessons from past and present change processes for continuous improvement?*	NO evidence of remedial actions taken or continuous improvement.	YES, there is evidence of remedial actions taken, but not continuous improvement.	YES, problems are resolved throughout the project, remedial actions are taken, and there is evidence of continuous improvement.	
	Stakeholder Engagement & Communication Plan	To ensure stakeholder inclusion and continuous learning, regular feedback mechanisms are necessary to ensure the reiteration of change process if failure is occurring.	*Do you have a stakeholder engagement and communication plan to obtain feedback on the adoption process for the new technology?*	NO stakeholder engagement and communication plans were developed.	YES, a plan was developed, but not for all stakeholders, and it did not include actions that will assist towards adoption.	YES, a detailed engagement and communication plan was developed that includes actions to assist adoption.	
	Training Programs/Material/Guides	To empower stakeholders to change, the relevant training guides and programs to change.	*Have you provided the necessary training programs/materials/guides for the new technology that will be implemented for the end user?*	NO program or materials/guides were developed.	YES, but it does not cover all aspects needed to assist with adoption and utilisation.	YES, all necessary programs and materials/guides were developed.	
	Transparent Communication of Project Implementation Plan	Adoption and change are enabled once processes are transparent, understood, and accepted by the stakeholders involved.	*Have you implemented and communicated a detailed plan showing the project's implementation tasks in sequence, linked to responsible individuals, with milestone dates and budgetary requirements?*	NO implementation plan was developed for this project.	YES, but it does not state detailed action steps, responsible persons, timelines and budget.	YES, a detailed implementation plan was developed stating all relevant action steps linked to responsible individuals, along with timelines and budgets.	