



MANDELA MINING PRECINCT
MINDS FOR MINES

Guideline:

The application of change management for the adoption of modern mining technologies

SATCAP 2023: WP 2.3 – SKILLS

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 to revitalise mining research, development and innovation in South Africa to ensure the industry's sustainability. 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 planet, profit, and people, SATCAP lends support to the environmental, social and governance (ESG) agenda, with specific focus on the social or 'benefits to people' aspect.

SATCAP 2023 Change Impact Evaluation Guideline

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CHAPTER 1

Introduction & Background

1. INTRODUCTION AND BACKGROUND

This project was commissioned by the South African Mining Extraction, Research, Development, and Innovation (SAMERDI) strategy's Successful Application of Technology Centred Around People (SATCAP) programme. The SATCAP programme aims to understand the effects, impacts and challenges of mining modernisation on people in the minerals sector. SATCAP lends support to the Environmental, Social, and Governance (ESG) agenda, with a deliberate focus on the social aspect. The project was led by Enterprises University of Pretoria (EUP), with collaboration partners including SML4Change, Louis Allen SA, the Research Institute for Innovation and Sustainability (RIIS), and the Council for Scientific and Industrial Research (CSIR).

The aim of this project was to design a Change Impact Evaluation (IE) Dashboard to enable the determination of people-related change impacts in the adoption of modernisation. The project follows on from the related 2022 project that focussed on the development of a Change Management Blueprint for the mining industry for the adoption of modern technologies. South African mines are modernising for improved safe production and sustainability, amongst other reasons. In so doing, the adoption of new technologies and systems is inevitable, and with this, change management becomes crucial. The tool developed in 2022 enabled mines around change management. The Change Management Blueprint was based on Minerals Council South Africa's Mining Industry Occupational Safety and Health (MOSH) Leading Practice Adoption System (Malatji and Stewart, n.d.) and linked to Awareness, Desire, Knowledge, Ability and Reinforcement (ADKAR) principles (Prosci, n.d.). The MOSH Leading Practice Adoption System remains an imperative for health and safety in South African mines, and the Change Management Blueprint does not replace the MOSH Leading Practice Adoption System but lends support to it. In 2023, the Change Management Blueprint was verified and interlinked to inform a Change IE Dashboard. This project was linked with other SATCAP projects conducted in the 2023 financial year, including WP 2.1 (Socio-Economic Transformation IE Dashboard) and WP 2.2 (Impact of Automation Dashboard).

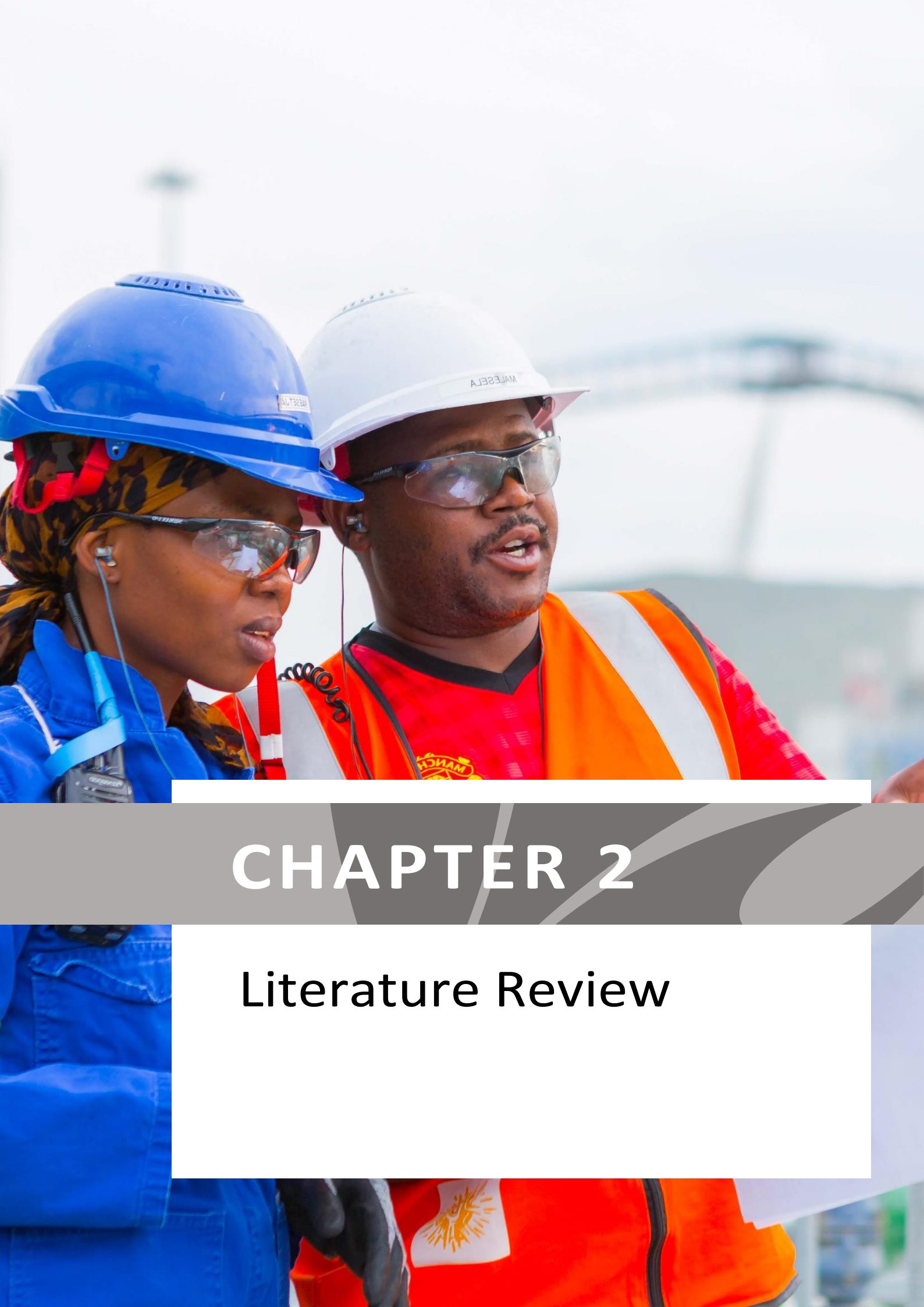
This guideline considers the SATCAP 2022 Change Management Blueprint, as it informs the key indicators for the Change IE Dashboard developed in 2023, and delves deeper into the success factors for change management application through two case studies. Verification of the above-mentioned change tools was done with South African mine partners, which included a platinum group metals (PGM) mine and a gold mining company. South African mines have different mining contexts and are in different phases of modernisation, so such case studies become important to understand success factors for change management application in such mining contexts. Learnings were observed. Hence, this guideline focuses on the case studies conducted, including the success factors needed for the application of the change tools to enable change management in the adoption of modern technologies. The Change Management Blueprint as linked with the Change IE Dashboard (also referred to as the Change Impact Dashboard) is highlighted as appropriate for the application of change management for technology adoption.

As such, the objectives for this project in 2023 were as follows:

- To verify the SATCAP 2022 Change Management Blueprint; and
- To interlink the Change Management Blueprint to a Change IE Dashboard.

Verification of the 2022 tool took place through site engagement and the practical application of the Change Management Blueprint. Further, mines needed to be able to gauge the impacts of change due to modern technology and systems adoption, and hence the need for a Change IE Dashboard.

The Change IE Dashboard design criteria and key indicators were identified through desktop research and in workshops with stakeholders, including subject matter experts and project partners. An iterative approach was used for drafting the Change IE Dashboard. Collaboration took place between the SATCAP work packages to create a unified ESG Impacts Lens Dashboard, which includes views of the change impacts, socio-economic transformation impacts, and automation impacts. User testing took place at mine sites. Ethics approval for the project was received (EMS207/23).



CHAPTER 2

Literature Review

2. LITERATURE REVIEW

Numerous factors can hinder or facilitate the implementation of new technologies, and mixed successes have been reported in the South African mining industry (Pelders and Schutte, 2021). Barriers to and facilitators of the successful implementation of new technologies are listed in Table 1. Further success and failure factors for the adoption of new technologies in the South African mining sector identified in previous SATCAP research are described in Table 2 (Pelders *et al.*, 2019). These factors relate to job profiles, skills and training, health and safety, ergonomics, work systems, workplace culture, and implementation processes.

Table 1: Barriers and facilitators to the successful implementation of new technologies (Pelders and Schutte, 2021)

Barriers	Facilitators
• Premature application of technology • Initially high or unexpected costs • Employee attitudes or resistance to change • Fear of job loss as a result of the technology • Suspicion of management motives • Poorly engineered work systems • Technical failures • Poor ergonomics • Inadequate human-machine interface design • Inadequate training or skills • New health and safety risks created • Poor implementation, planning and control • Difficult mining conditions	• Optimal design of equipment • Human-system integration • Technology appropriate to work system • Technology maturity • Usability • Operator acceptance • Knowledge transfer • Training and support • Communication and coordination • Ownership of the technology or work system by the workforce • Worker involvement • Trust in the technology • Quantified benefits • Common vision

Table 2: People-related success and failure factors for the adoption of new technologies (Pelders *et al.*, 2019)

Factor	Description
Job profiles	Fear of job loss can hinder the adoption of new technologies. However, new technologies could result in the creation of new jobs, along with improved productivity and extended life of mines.
Skills and training	A lack of skills could be a hindrance to the adoption of new technologies. However, new technologies provide opportunities for the development of new skills.
Health and safety	Modernisation can help to drive improvements in health and safety in the mining industry. However, new health and safety risks could be created.
Ergonomics	The fit between the technology and the user will affect its adoption, as it needs to be comfortable and useable. People-centred design is recommended.
Work systems	The technology needs to be suited to the environment in which it will be placed. The whole work system will need to change with the implementation of new technologies. These include aspects such as the organisational structure, resources, processes and performance measures, in addition to mine layouts and systems.
Workplace culture	A lack of trust is a hindrance to collaboration and the acceptance of technologies. Culture transformation will be required to address resistance to change.
Implementation process	All stakeholders should be involved in the modernisation process to build trust, for buy-in, acceptance and support. An inclusive change management process should be implemented and shared value created. The development of local manufacturing capability and creation of a globally competitive market will increase the preference and uptake of local equipment.

Ntsoelengoe (2019) similarly assessed factors necessary for effective adoption of modernisation in the South African mining industry. An adoption model, including enablers, inhibitors, and adoption factors, was developed as shown in Figure 1. The key adoption factors identified included:

- Business value drivers associated with perceived benefits;
- Execution processes to ensure integration of technology into current business processes;
- Change management and communication; and
- Stakeholder engagement.

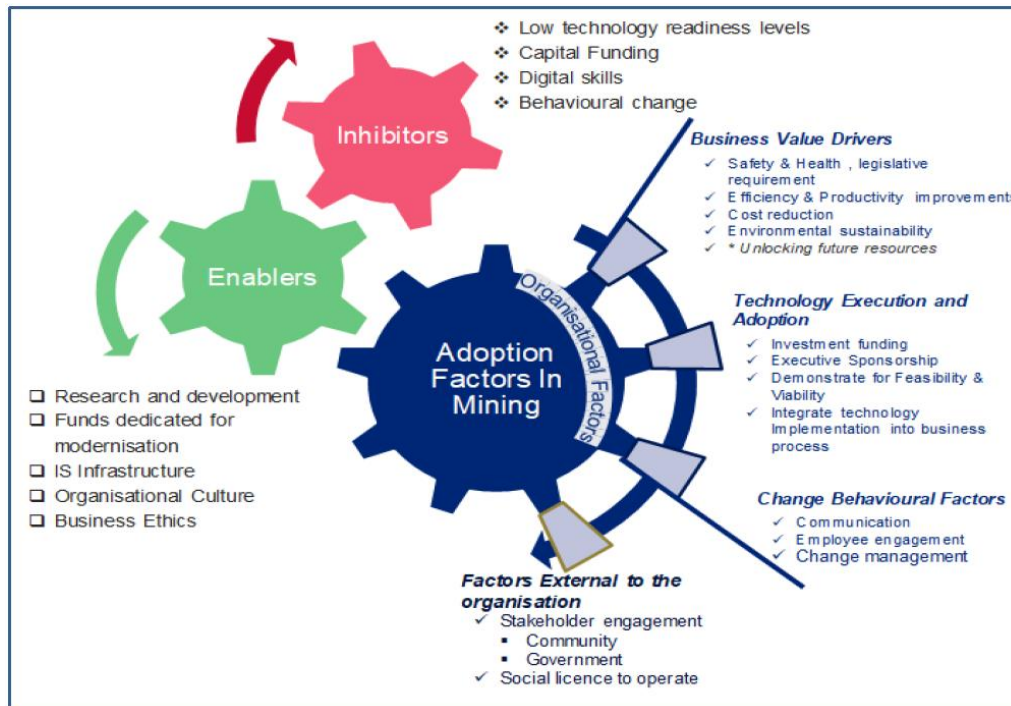


Figure 1: Proposed modernisation adoption model for the mining industry of South Africa (Ntsoelengoe, 2019)

Learnings arising from the technology adoption case study conducted at a conventional gold mine by Botha *et al.* (2023) are described in Table 3. The list is non-exhaustive, and it is recommended that each operation develops their own list of considerations prior to commencement of the technology adoption project. Further learnings identified included:

- There is a need for people applying the Change Management Blueprint to understand the concepts of “change management” (the people side of change) versus the “management of change” (the technical side of change);
- Completion of the business case, due diligence, and organisational approval is required before the implementation of the Change Management Blueprint;
- The Change Management Blueprint can be used either as a full change management process/toolkit or parts can be used to supplement an existing change management process/toolkit that the company already uses; and
- The Change Management Blueprint can be used as a remedial tool to evaluate past change management interventions to improve preparations for future change management interventions.

Table 3: Considerations prior to Change Management Blueprint implementation (Botha *et al.*, 2023)

Considerations	Description
Skills and training on technology	The mine operation needs to consider the levels of skills needed, training/knowledge that the relevant role-players have with regard to the specific technology, and if these are lacking or limited, put in place development plans to address these.
Literacy levels	Consideration must be provided to the literacy levels of the users in the specific technology. More broadly there is also the need to understand the digital literacy of the project team and users of the technology.
IT infrastructure and systems	Sites may be willing to undertake the adoption of new technologies but there may not be sufficient information technology (IT) infrastructure (both hardware and software). Mine operations thus need to consider and investigate the technology support structures that are required for adoption of the new technology.
Environmental considerations/working conditions	It is necessary to understand the environment in which the technology will operate. Conditions, such as the physical environment, need to be assessed (e.g. narrow, low stopes, confined, dusty, hot, and wet working conditions). Furthermore, for example, inputting data may be cumbersome and clumsy, and if personal protective equipment (PPE) is to be removed, such may create unsafe working conditions.
Unions and DMRE/Stakeholder inclusion	Agreement, buy-in, inclusion and support are needed from all stakeholders, including unions, regulators and employees. Health and safety risks and concerns should be addressed. Lack of stakeholder engagement leads to resistance to the acceptance of the change. There may be demands for increased job levels and pay for new skills/higher skilled jobs (current job profiles do not include use of digital devices and digital literacy skills). Individual employees are also concerned that technology will track and monitor their actions with negative consequences. Compliance and regulatory issues need agreement prior to further engagement.
One-size fits all approach	Mine conditions, environments and contexts vary so mine operations cannot use the same product/system on every mine – even shafts have different needs.

Critical Success Factors (CSFs) need to be addressed prior to the application of change management in technology adoption. CSFs are not a measurement of success, but rather the systems through which a company succeeds. These systems work in the “background” of operations and projects at all times (Yarborough, 2021). CSFs for the adoption of new technologies, identified in Botha *et al.* (2023) and verified in the current project, included:

- **Organisational digitisation journey:** There is a need for the company digitisation journey map to be communicated, as stakeholders need to understand how and where the technology initiative fits into the site strategy and operational structures. There may be concerns about the maturity of specific operations to adopt technology and the lack of reassurance from a company perspective of an integrated plan. Progress of other initiatives and priorities of initiatives have an impact on the digitisation journey and the contextualisation of efforts need to be understood and be reflected on.
- **History assessment/reflection/review:** Projects may lack a consistent review process, such as in following a Plan, Do, Check, Act (PDCA) cycle towards quality improvement. Projects need to make provision to share learnings from other projects before new initiatives commence, as reflection and review may prevent future challenges and keep the organisation accountable. Further, the industry needs to share learnings, at industry forums allowing to capacitate the journey; and stakeholders need to be included such opportunities.
- **Current versus future resources:** Previous initiatives impact on the perceived probability of success and set the tone for determination of future success. Before the change process journey can commence, the resource plan needs to be reviewed, as there is a difference between what is currently done versus what is wanted or needed. The change management approaches and methodologies were found to be critical during this phase to ensure cultural alignment.



CHAPTER 3

Findings & Recommendations

3. FINDINGS AND RECOMMENDATIONS

This section details the key findings of the case studies and related recommendations on the success factors needed for the application of the Change Management Blueprint. Two case studies were conducted as follows:

- Adoption of a plant inspection checklist at a conventional gold mine; and
- Adoption of a digital Shiftboss logbook at a modern PGM mine.

The adoption of a digital plant inspection sheet used within a gold mining operation was used as a case study for the piloting of the draft Change Management Blueprint (Botha *et al.*, 2023). This was further verified in the 2023 project. The plant inspection sheet is used as a method to identify potential hazards and risks surrounding a specific plant and machinery, to ensure operations are compliant with safety, health, and environmental regulations. The technology adoption project involved the transfer of the plant inspection sheet to a digital platform.

The second case study involved the use of a Shiftboss logbook for the practical application of the Change Management Blueprint. Shiftboss logbooks are legally required. In this case, the manual logbooks used were to be replaced by digital logbooks. The digital logbooks would enable the receipt of real-time information and reports, and could be signed digitally. Learnings from the practical application of the Shiftboss logbook are summarised as follows:

- **Technology readiness and functionality:** Data security is increased through ensuring logbooks are provided and managed by operations, and no personal devices are utilised. The offline capability was not always active indicating that the technology readiness assessment was not conducted in full. The dimensions (weight and user interface) were well developed and indicated that ergonomic and intuitive design principles were followed.
- **Contents on device:** Procedures and standards on the device enables employees to refer to what is expected from their inputs and use. It provides guidance that could have a positive effect on the accuracy of Shiftboss reporting. The digital platform also ensures that the latest inspection lists are available.
- **Procedure:** A Shiftboss can apply for Mine Overseer approval on checklists. This ensures there is real-time application and contributes to accurate information sharing. The procedures are also outlined in a step-by-step approach which contributes to the full completion of all sections in the logbook. This has a positive impact on the compliance to procedures. There is still uncertainty of the legislative amendments that will be made with regards to the digital application of the logbooks; however, testing is continuing to ensure that operations can roll-out technology once legislation is aligned.
- **Change management:** The technology has been found to be people-centric with clear intuitive design in the software. The easy-to-understand format of the logbook ensures there is greater acceptance and therefore makes the change management in the adoption of the technology less difficult. It was observed that a modernised/technology-ready operation requires less intensity in change management and has created a sense of awareness and shared knowledge on technology.

Further learnings from the validation process, including through literature sources, were around key behavioural considerations, as described in Table 4. These considerations provided guidance to the people readiness criteria within the Change IE Dashboard.

Table 4: Behavioural considerations

Behaviour	Description
Technological Readiness (TR)	The morale and productivity of employees may decline if users are uncomfortable or lack confidence in new technology. It is necessary to understand the propensity of adopting the new technology. TR refers to a combination of mental incentives and inhibitors that largely determine people's willingness to use new technology.
Behavioural Intention (BI)	BI describes the eagerness with which an individual considers the formal adoption of innovation once it becomes readily available.
Performance Expectancy (PE)	PE is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance."
Effort Expectancy (EE)	EE is the degree of ease with which users expect to use a chosen technology.
Optimism	Optimism refers to an optimistic outlook toward technology and the notion that it affords people more control, flexibility, and efficiency in their daily lives.
Innovativeness	Innovativeness describes the propensity to be a technological pioneer and intellectual leader.
Discomfort	Discomfort involves a sense of being overwhelmed by technology and a perceived lack of control over it.
Insecurity	Insecurity refers to distrust of technology based on doubts about its capacity to function effectively and fears about its potential for damaging outcomes.

Both case studies justified the inclusion of the Critical Success Factors (CSFs) as the most significant contributors to the success of change management processes. The CSFs are viewed as the input required to engage with people and commence with the identification of people-centred work to be done (Botha *et al.*, 2023). Through tool review and verification during the second case study, the CSFs were further revised, to include a fourth factor, namely: **Digitisation and modernisation governance**. There is the need to clearly identify the governance structures, including policies and procedures, that will dictate the adoption of the technology. The lack of governance structures has been noted as a negative impact on the technology adoption process. Clear governance ensures that there is accountability taken for the adoption process and increases compliance and security.

A summary of the validation process for the CSFs are shown in Table 5.

Table 5: CSF validation process

Element in Change Management Blueprint	Description	Industry validation	Summary of observations
Organisational digitisation journey/technology roadmap	When engaging with your team members, the digitisation roadmap can visually illustrate the journey and also the aspects that should receive attention. During the process, the impact on people is acknowledged. Engage earlier rather than later.	• Contextual positioning • Reason for the change • Integration and target • Clarify the intent of the technology and process • Timeframe and transition period • Cost or incentive implications	• Understanding the digital transformation journey • Assisting to guide and manage change • Enhancing communication and collaboration
History assessment/lessons learned	Opportunities should be created with current worksite to reflect on lessons learned with previous technology initiatives. It is also advisable to benchmark within the company where other or similar technologies were implemented.	• Leverage on stories • Reality check of blind spots • “Bank” the lessons and sharing of ideas • Identify fear and mitigate the risk	• Learning from successes and failures • Personal narratives: Worker perspectives; leadership and decision-maker insights • Oral history and documentation
Current versus future resources	Current resources and/or what is already in place for the current project.	• Confirmation of sponsorship and capacity/lack of capacity • Confirmation of enablement and credibility • Reduce uncertainty	• Resource planning as a pillar of change management: Cost efficiency, skills development, technology acquisition, and timely implementation • Reducing resistance and instilling hope: Transparency, inclusivity, and mitigation of risks
Modernisation and digitisation governance	Policies and procedural requirements and interface.	• Technology interface and accountabilities • Process of issuing • Process of servicing and accountabilities	• Accountability and transparency • Risk management • Efficient resource allocation • Effective decision making • Stakeholder engagement • Long-term sustainability • Compliance and legal considerations • Cybersecurity • Quality assurance



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CHAPTER 4



Change Management Tools for
the Adoption of Modern
Technologies

4. CHANGE MANAGEMENT TOOLS

Effective change management is important for the successful implementation of new technologies. The SATCAP programme has considered a Change Management Blueprint (2022), which links into a Change IE Dashboard (2023).

Change Management Blueprint and the Change IE Dashboard

The development of the Change Management Blueprint is outlined in Botha *et al.* (2023). The 3PRS Change Management Blueprint for the adoption of modern technologies in the mining industry, Microsoft Excel Tool, guideline, poster and How-To-Video may be accessed on the Mandela Mining Precinct website (<https://mandelaminingprecinct.org.za/change-management-blueprint/>). The Change Management Blueprint incorporates the five phases of prepare, plan, pilot, roll-out and support, which each have sub-steps that need to be completed prior to moving to the next phase. The process is indicated in Figure 2.

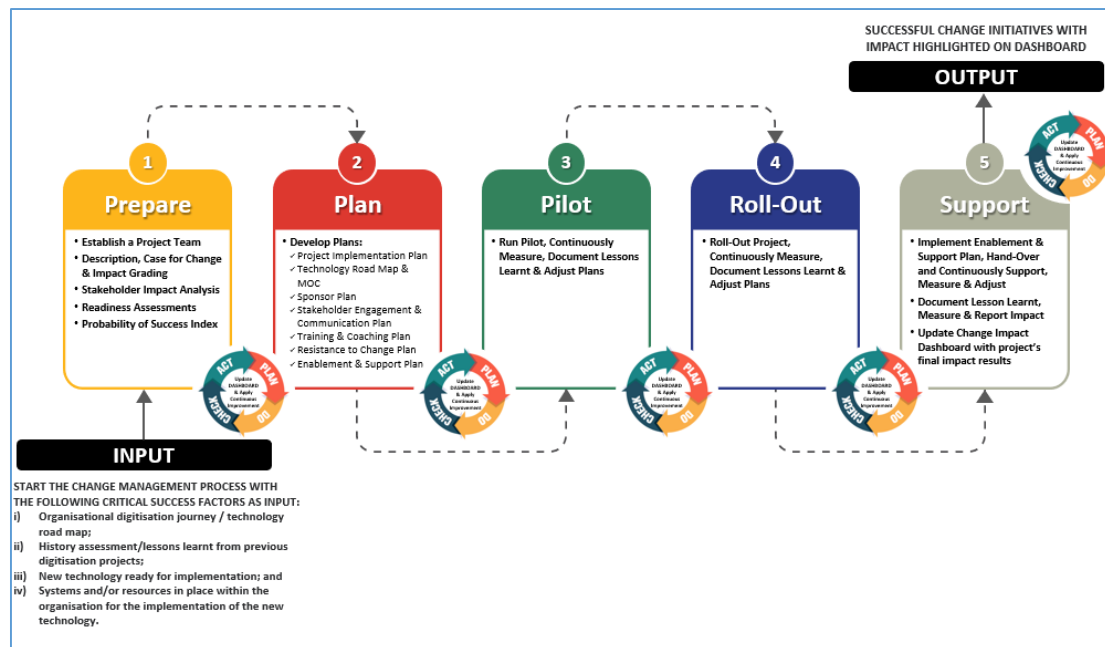


Figure 2: Change Management Blueprint^{v2}

The Change Management Blueprint informs the key indicators for the Change IE Dashboard. Table 5 describes the key indicators. The consolidation of user-testing feedback produced the following outcomes:

- The data sources for the Change IE Dashboard included the integration and links from the SATCAP 2022 Change Management Blueprint;
- A Change IE Dashboard was drafted, with key indicators. There are 18 key indicators and five integrated underlying sub-dashboards;
- Business priorities of safety, cost, production and people are also key considerations; and
- Each indicator has a “help” icon which describes what the indicator represents and how it can be interpreted to inform decision-making.

Table 5: Change IE Dashboard key indicators

People impact	
Number of people using the technology	This indicates the extent to which the technology is being applied across various levels of persons in the operation. It further indicates the intensity of focus areas in change management application.
People's proficiency in using technology	The determination can be made on how persons will cope with using the technology. It also outlines the need for level and intensity of training.
People's satisfaction with new technology	This indicator outlines the ease with which people will adopt the new technology. It was found that if persons have higher satisfaction of use, then there would be higher acceptance of the technology and therefore increase adoption probability.
Change adoption impact	
People's awareness of the new technology	The use of change management principles in the adoption process requires people to be made aware of the new technology. This increases the probability of success in the adoption process.
People's desire for the new technology	The positive desire of persons to utilise the technology has a direct link to the success of adoption
People's knowledge of the new technology	New technology adoption is often made difficult due to users not understanding the technology. The increase in knowledge lets users understand how the technology is applied and benefits their position.
People's ability to use the new technology	Users often resist the change taking place because they do not have the necessary ability to use the technology. The measurement of this indicator will also inform the training plan of the technology adoption project.
People's support for the new technology	The adoption process is made easier if users support the technology. It also has a more positive impact on fellow employees and the roll-out of technology in other sections of operations is users speak and interact positively around the technology.
Technology impact	
Leadership readiness for implementing the technology	This indicator outlines whether the leadership team for the adoption project has been successfully established. Further to this the indicator will highlight the level of understanding and support that is provided by leadership to the technology adoption project.
Organisational readiness for implementing the technology	This indicator illustrates the understanding that the organisation has of the technology. It also outlines the technology strategy and whether this is established within the organisational operating models.
Technology readiness for implementation	This is an indicator that is often overlooked, and the application of the Change Management Blueprint illustrated that there is need for operations to determine the practical readiness (i.e. systems, current technology plug-in, support services, etc.) for the technology project.
Organisational policies, procedures, and processes in place for implementation	There is the need for operations to have the necessary governance structures in place to have a higher probability of success. The measurement of these aspects will highlight to the implementing operation whether they have the necessary governance and procedural structures to manage the technology adoption process.
Organisational impact	
People results	This is the indicator that outlines the positive or negative impact that the change has had on the people within the organisation.
Internal business process results	This indicator will inform management of whether there has been an improvement in the business processes after the adoption of the new technology.
Internal stakeholder results	Internal stakeholders have a strong driving force to the success of an adoption project. The measurement will indicate the impact that this has had on the internal stakeholders such as the users and related parties.
Financial results	The measurement will highlight the impact that there has been on the financial stance of operations after project implementation. It provides management with the necessary information to determine if the business case for the technology adoption has been successful and accurate.
Project indicators	
3PRS-Blueprint step progression	The indicator determines the progress to which the Change Management Blueprint has been implemented/used during the technology adoption project. It ensures that change management principles have been incorporated during the technology adoption project.

**Project management
(time, cost, and scope)**

This is an especially valuable indicator for management to determine the overall success of project implementation. These aspects within the indicator will clearly highlight whether the project has been managed within the basic parameters set.

ESG Impacts Lens Dashboard

As indicated, this project has linkages to SATCAP 2023 WP 2.1 (Socio-Economic Transformation IE Dashboard) and WP 2.2 (Impact of Automation Dashboard). A visually integrated ESG impacts evaluation dashboard was suggested by industry, to enable visualisation of impacts across the three areas, as per evident linkages amongst the impact dashboards. Thus, the three domain-specific dashboards were drafted, and were integrated into an ESG Impacts Lens Dashboard.

The Change IE Dashboard, with its related indicators, is specifically intent on gauging change impacts in the adoption of modern technologies. The Change IE Dashboard is available on the Mandela Mining Precinct website ([Successful Application Of Technologies Centred Around People \(SATCAP\) - Mandela Mining Precinct](#)). Screenshots of the ESG Impacts Lens Dashboard landing page and the Change IE Dashboard are shown in Figures 3 and 4.

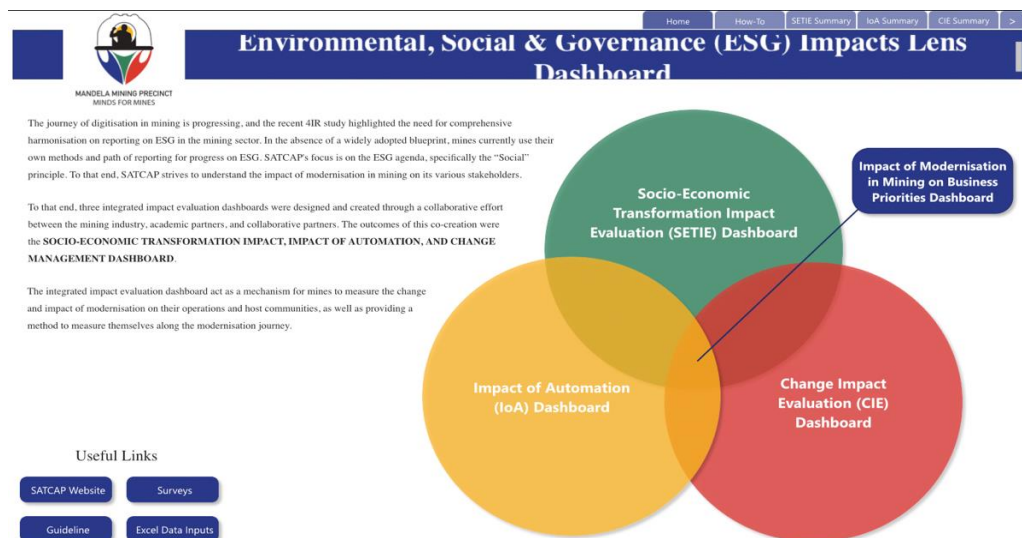


Figure 3: ESG Impacts Lens Dashboard landing page

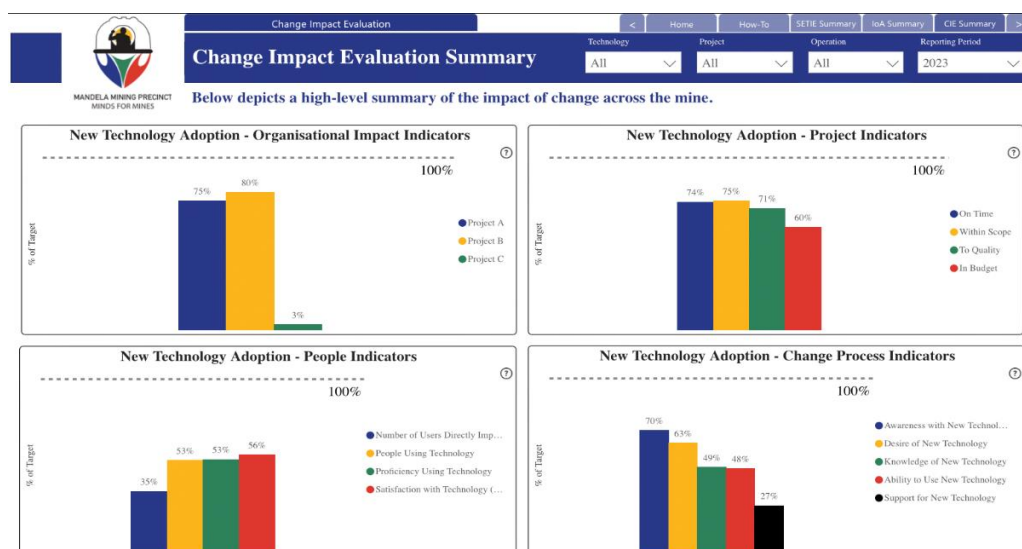


Figure 4: Change IE Dashboard



CHAPTER 5

Conclusion

5. CONCLUSION

In summary, as a result of literature review, stakeholder engagements, and partner mine case studies, the Change IE Dashboard (also referred to as the Change Impact Dashboard) was developed. The dashboard has three sub-dashboards and 17 key indicators, as identified and confirmed towards enabling the understanding and evaluating the impacts of change for technology adoption. Further, the Change Management Blueprint informed the key indicators for the Change IE Dashboard. These provided the underpinnings for the Change IE Dashboard. The data sources for this domain-specific dashboard include integration and links from the SATCAP 2022 tool and an Excel Workbook.

Key questions that motivated the construction of indicators for the Change IE Dashboard design in respect to the adoption of technology were:

- What is the impact of the adoption of new technologies on people?
- Where are people on the ADKAR spectrum to enable technologies' adoption?
- How ready is the organisation and people for adopting the new technology?
- What are the organisational impacts?

The Critical Success Factors (CSFs) that need to be addressed prior to the application of change management in technology adoption are the following:

- Organisational digitisation journey/technology roadmap;
- History assessment/review/lessons learnt from previous digitisation projects;
- Current resources and/or what is already in place with the organisation for the new project; and
- Digitisation and modernisation governance (policies, rules, and procedures).

The Change IE Dashboard integrates into the ESG Impacts Lens Dashboard, which consists of the Socio-Economic Transformation IE Dashboard (WP 2.1), the Impact of Automation Dashboard (WP 2.2) and the Change IE Dashboard (WP 2.3), with their key indicators. Furthermore, the ESG Impacts Lens Dashboard focuses on the key business priorities of people, productivity, cost, and safety.

Utilising the dashboard is supported by a *User-Guideline*. SATCAP tools can be found at <https://mandelaminingprecinct.org.za/successful-application-of-technologies-centred-around-people-satcap/>

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