MINING INDUSTRY OCCUPATIONAL SAFETY & HEALTH

MINERALS COUNCIL SOUTH AFRICA

LEDGING PLANNING, EXECUTION AND MONITORING LEADING PRACTICE (LEDGING LP) CASE STUDY

"The main intention was to improve the overall safety at the operation"

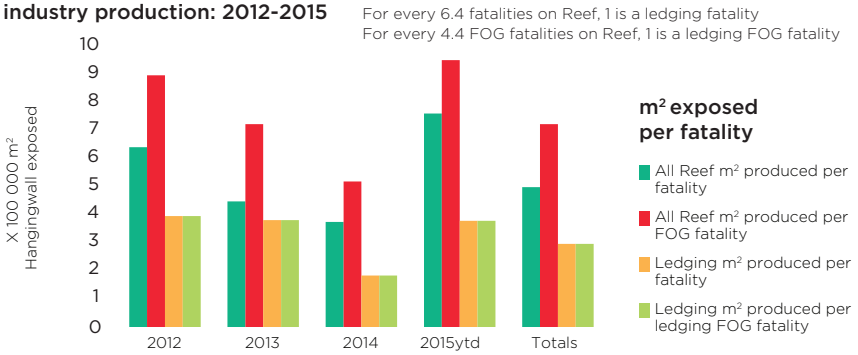
FULL DESCRIPTION OF THE RISK ADDRESSED

The ledging leading practice was adopted by the Kloof Upper section of the Kloof mining operation, located near Glenharvie, Gauteng on 24 January 2019. The main intention was to improve the overall safety at the operation, particularly during the process of ledging.

This leading practice was launched by the Mining Industry Occupational Safety and Health (MOSH) Learning Hub in June 2017, in response to the prevailing poor safety record in the mining industry's ledging stopes. It was designed to provide the industry with a set of principles, guidance on activities and leadership behaviour that could ensure a safe, sustainable and productive ledging operation. Although a variety of technical standards and practices are applied at various operations, a common approach can be applied to the ledging planning, execution and monitoring process.

During the documenting of the leading practice, it was highlighted that the fatality rate in ledges was twice as high as the rate in stoping – a significant disproportion considering the relative production (m^2) in ledging. The accident rate therefore was higher in ledging. Figure 1 illustrates the industry's statistics at the onset of the development of the Ledging LP.

Figure 1: The accident rate per production interval for the South African mining industry production: 2012-2015



OVERVIEW

Mining company

Sibanye-Stillwater

Commodity

Gold

Operation/Mine

Kloof Upper

Health and safety case study

Ledging planning, execution and monitoring leading practice (Ledging LP)

Number of employees affected by the health and safety case study

11

Stakeholders consulted

Full-time health and safety structures

Occupations affected/benefited

Mine manager, production and technical service personnel

In the Kloof Upper operation, prior to adopting the leading practice, the operation recorded six fall of ground (FOG) injuries in ledges over the last three years with no fatality. The mine, as part of the MOSH adoption process, identified the following challenges:

- That the lag time between starting up a raise and completing the first blast on the breast ledging was >two years and as such the probability of deterioration of the rock mass and ground support would be high. This would increase the risk during ledging
- Based on the numerous underground investigations and experiential evidence at the time, and noting the significant lead time described above, poor mining discipline in ledging was expected
- There was an absence of detailed guidelines that incorporated tasks, activities and duration to set up the developed excavations for ledging
- There was a general idea and belief that ledging is a quick process and that it was not as important as stoping

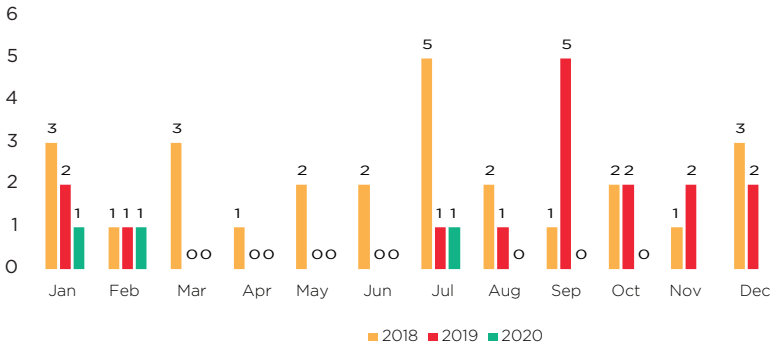
BENEFITS AND IMPROVEMENTS REPORTED BY AFFECTED STAKEHOLDERS

From the presentation and subsequent interviews with mine personnel, the mine highlighted the following benefits, directly from or indirectly through the adoption of the leading practice:

a) Health and safety improvements

The adoption process allowed the mine to retrain all their crews practicing ledging in the latter half of 2020. The MOSH adoption process improved the mining crews' approach towards entry examination and making safe, as well as the ledging process[1]. For the period of 2020, the mine recorded one injury, a significant improvement clearly articulated in Figure 2. The number of FOG accidents have reduced significantly from 25 in 2018 to three in 2020.

Figure 2: Sibanye-Stillwater Kloof Upper FOG statistics: 2018-2020



[1] *The full-time health and safety representative, Ernest Fukusi, attested this outcome to improved hazard awareness and post-adoption accident statistics, lending credibility to the Ledging LP*

b) Operational benefits

A new approach to ledging has been developed by the mine as part of the leading practice adoption. This approach includes the following changes in the execution of ledging:

1. Regular meetings during ledging are held between senior and middle management, including service departments to allocate roles and responsibilities. This has improved cooperation between production teams and service departments.
2. A Master Plan (mandatory requirement of the Ledging LP) is developed for all ledges including detailed tasks to be undertaken and the responsible person is allocated to each task. It is imperative that roles and responsibilities are clarified to ensure that the Master Plan is adhered to. The Master Plan entrusts the ownership of the whole process to the 3.1 appointee.

FINDINGS AND LESSONS LEARNED FROM THE ADOPTION OF THE LEDGING LEADING PRACTICE

The mine highlighted that the adoption process of the ledging leading practice contributed the following lessons:

1

The behaviour of the leaders on the mine holds the key to performance outcomes of the operation - the actions of a leader, good or bad, are observed by subordinates and all employees.

2

Responsibility and accountability have to be assigned correctly to different employees across various levels involved in the ledging process.

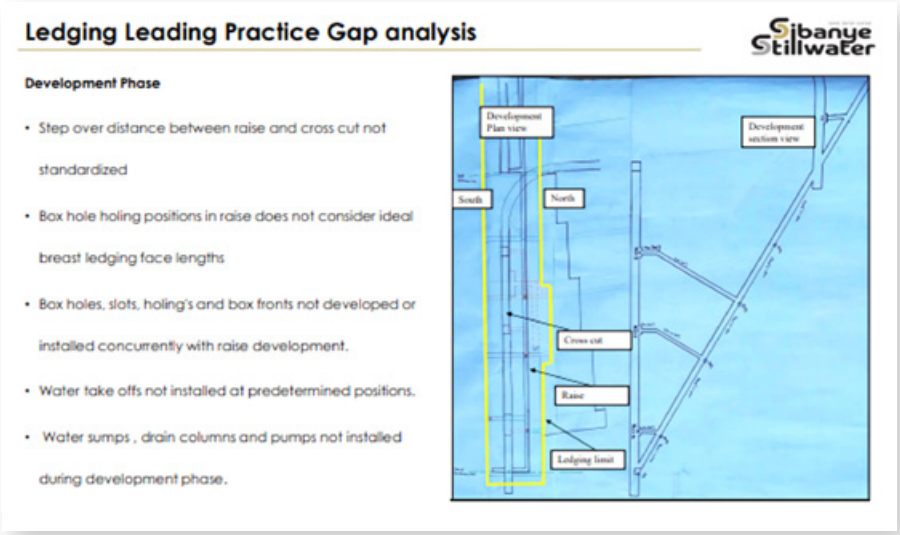
3

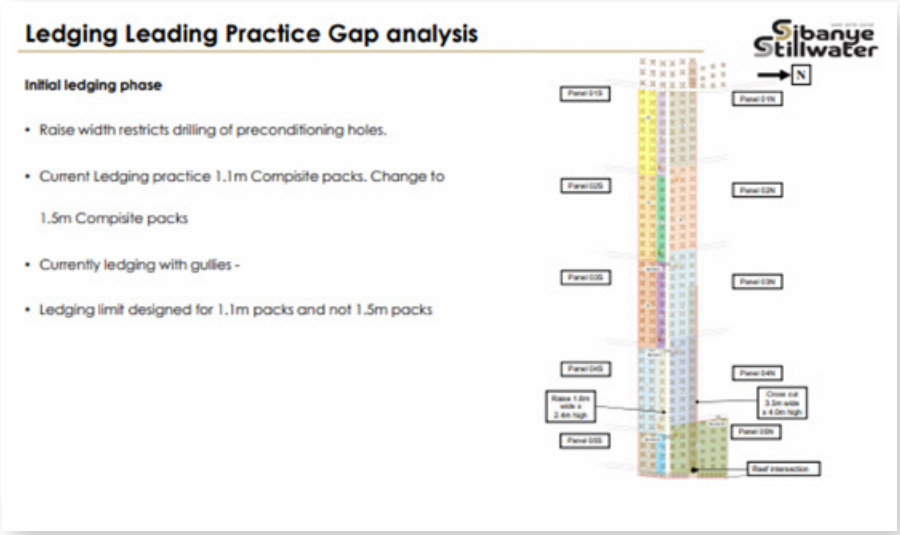
In order for the leading practice to be embedded and sustainable in the longer term, the operation invested resources (dedicated mine MOSH team, additional resources for ledging infrastructure) as well as time and effort into the adoption process.

4

With the fostering of closer relationships between managers and employees, and allowing employees to present their concerns, the mine has benefitted significantly.

3. All crews have received on-site training by the mine MOSH adoption team on the revised best ledging practice procedure and standards. This is in contrast to the general training received at the training centre.
4. This has been supported by regular multi-disciplinary underground visits for progress monitoring which is now part of the new mine standard.
5. The MOSH adoption process and the gap analysis segment of the Ledging LP also yielded the following designs modifications, which improved the efficacy of the mine design (development phase; initial ledging phase and reef intersection):





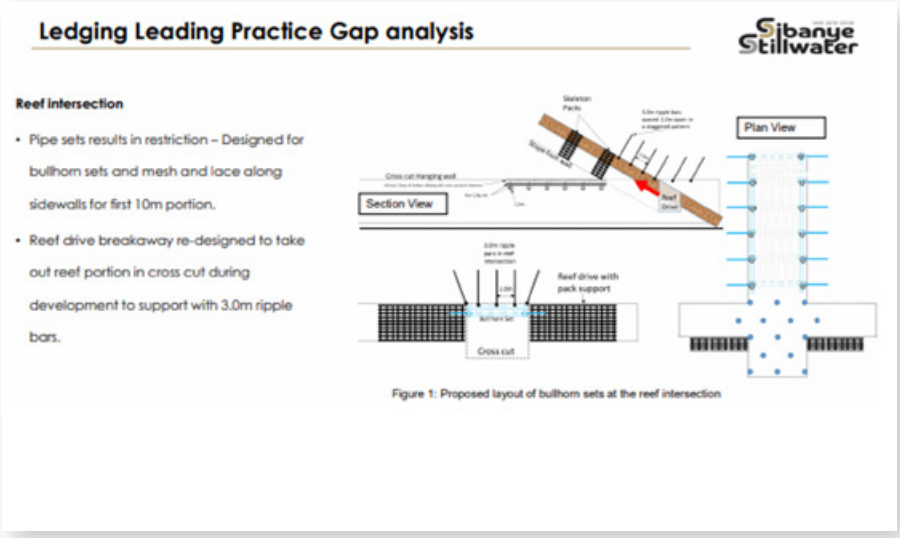


Figure 1: Proposed layout of bullhorn sets at the reef intersection

"All crews have received on-site training by the mine MOSH adoption team on the revised best ledging practice procedure and standards."

c) Production benefit

The adoption of the leading practice allowed the mine to execute the ledging process within the planned time, according to the adoption project plan. The knock-on effect was that the stoping crews could move in without delay. The diligent nature of the planning process, the detailed execution, according to the master plan and the appropriate control measures, have contributed significantly to the improvement in overall production and safety. Some key production drivers that were improved were:

1. The panels that were fully equipped prior to stoping which made the transition to stoping less disruptive.
2. General conditions in the stopes improved with good housekeeping, less ore accumulation and good water control.
3. The mining discipline improved significantly following adoption as it was observed that permanent support was always installed on grid lines, with strike and centre gully lines always drawn in position.
4. There was an overall improvement in the hanging wall conditions.

d) Realised improvement with mining crews

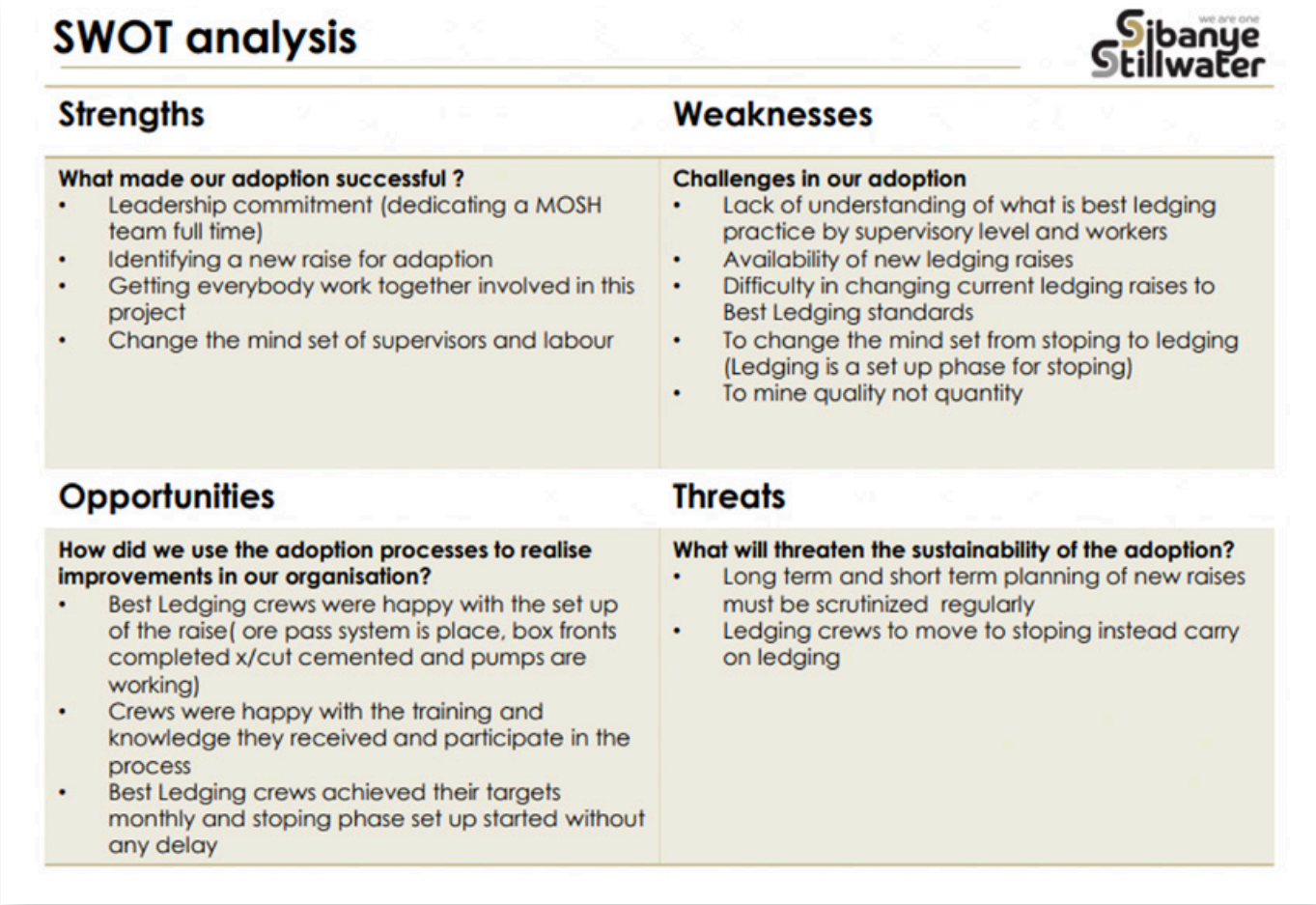
Apart from the production and safety performance improvements, more importantly, the people felt empowered:

1. From a behavioural, communication and leadership point of view, the adoption process facilitated the further resolution of relationships between managers and employees.
2. Crews were given more information on the new ledging approach and points of concern were clarified during the adoption process. In this context, it is surmised that the new standards and procedures were better understood and well-articulated.
3. The feedback from the focus group discussions highlights gaps in knowledge, communication and attitude. This communication further improved individual understanding and expertise within the mining crews.
4. Crews felt privileged and empowered to have been involved in the process which resulted in ownership of the execution process across all levels.
5. The ledging crews were happy with the set-up of the raise lines (ore-pass system in place, box fronts completed, x/cut cemented and pumps working).
6. The mine resolved to name their ledging practice as the best ledging practice and all crews were trained, not only the ledging crews. It was envisaged that if all crews were conversant with the specific requirements of the ledging practice that when stoping crews moved to ledging, the transition would be less problematic.

"The mine resolved to name their ledging practice as the best ledging practice and all crews were trained, not only the ledging crews"

OPERATION'S STRENGTH, WEAKNESS, OPPORTUNITY AND THREAT (SWOT) ANALYSIS

From the presentation referred to above, the operation summarised its Ledging LP adoption with the following SWOT analysis, and the content has paved the way for other mines in the group to adopt this leading practice.



SWOT analysis

Sibanye Stillwater

Strengths	Weaknesses
What made our adoption successful ? • Leadership commitment (dedicating a MOSH team full time) • Identifying a new raise for adaption • Getting everybody work together involved in this project • Change the mind set of supervisors and labour	**Challenges in our adoption** • Lack of understanding of what is best ledging practice by supervisory level and workers • Availability of new ledging raises • Difficulty in changing current ledging raises to Best Ledging standards • To change the mind set from stoping to ledging (Ledging is a set up phase for stoping) • To mine quality not quantity
Opportunities	**Threats**
How did we use the adoption processes to realise improvements in our organisation? • Best Ledging crews were happy with the set up of the raise(ore pass system is place, box fronts completed x/cut cemented and pumps are working) • Crews were happy with the training and knowledge they received and participate in the process • Best Ledging crews achieved their targets monthly and stoping phase set up started without any delay	**What will threaten the sustainability of the adoption?** • Long term and short term planning of new raises must be scrutinized regularly • Ledging crews to move to stoping instead carry on ledging

Sibanye-Stillwater Kloof Upper Ledging LP adoption sponsors:

- Keith Stead – Vice President: Kloof Upper
- Karel de Lange – Vice President: Kloof Upper

LEDGING TEAM

Sibanye-Stillwater Kloof Upper MOSH adoption team:

- Dawid Nel – Mining manager
- Suleyman Ogras – Project leader
- Shaun Lyons – Training officer
- Duncan Griesel – Safety officer
- Elris Du Toit – Rock mechanic
- Ernest Fukusi – Full-time health and safety representative

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