2016 AREAS OF FOCUS continued

Modernisation –
advancing the mining cluster through R&D and manufacturing

After the Mining Phakisa Lab in 2015, considerable progress was made by the Chamber's Modernisation team in 2016 to establish 'Quick-Win' R&D programmes that will ensure delivery on user-based R&D requirements. These requirements have been clearly articulated, in terms of solutions that are required to ensure the sustainability of the industry, especially in the gold and platinum sectors. Essentially, 2016 was a year of formulation, whereas 2017 will be a year of implementation.

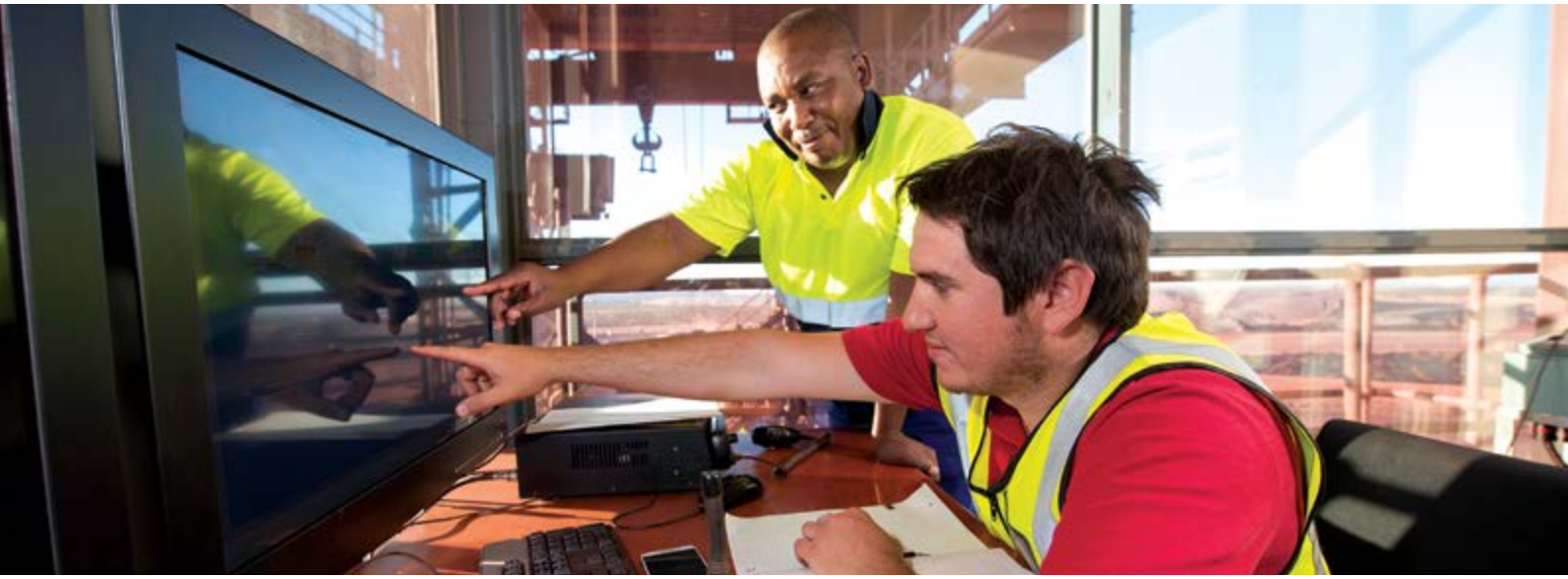
The main achievements of 2016 were:

- Agreement amongst stakeholders to develop a model based on Public-Private Partnership for the mining cluster, based on the principle of Open Innovation.
- The commitment of the Department of Science and Technology (DST) to the re-establishment of the Council for Scientific and Industrial Research (CSIR) site at Carlow Road for collaborative mining research and manufacturing development with representation from the CSIR, the Chamber of Mines and equipment manufacturers.
- The establishment of the Mining Equipment Manufacturers of South Africa, as a Cluster Development Programme, supported by the DTI.
- The development of detailed Charters for the Seven Quick-Win Programmes as the core of the R&D programme by the mining industry, through the Chamber's Innovation Team.
- Being awarded a budget of R150 million over three years of government funds in the Mid-Term Budget Statement.
- Securing, in principle, an agreement on a test-mine facility that will be open to all participants.
- Implementation of a communications programme around modernisation culminating in a dedicated Mining 2030 webpage.

1. **Sietse van der Woude**
   Senior Executive: Modernisation and Safety

2. **Katlego Letsoalo**
   Intern: Modernisation and Safety

IMAGE
Kolomela Mine is Kumba's newest mining operation



QUICK-WIN PROGRAMMES

These programmes are based on industry needs, as well as national needs, with the aim of improving the contribution of the mining sector to the economy on a sustainable and inclusive basis. The programmes are divided into those affecting current mining operations, mechanised mining and non-explosive rock breaking as illustrated in the diagram below.

MODERNISATION OF CURRENT MINING OPERATIONS

This involves ensuring the sustainability of current operations, by ensuring work is done more efficiently, safely and healthily through the introduction of modern practices and appropriate technologies.

The focus is to increase the efficiency of extraction and improvement in occupational health and safety, as well as cost reduction.

MECHANISATION, USING DRILLING AND BLASTING

As this involves application in both the gold and platinum sectors, there are two work streams in this area.

The main theme in these areas is to remove people from dangerous areas and introduce remote operation throughout the mining cycle. In addition to the technical challenges, a systems engineering approach is essential.

The aim is to develop fully mechanised mining systems that will allow for the drilling of narrow hard-rock mines (particularly gold and platinum).

NON-EXPLOSIVE ROCK BREAKING

While attempts have been made in the past, and continue to be made, to develop hard-rock continuous mining systems these have not proven to be successful. Significant fundamental research work is required in this area to develop rock-breaking technology, as well as the fully integrated continuous mining system of the future. This will require significant research into rock engineering aspects, designs and supporting systems.

The goal is to develop complete systems for extraction that are completely independent of the use of explosives.

ADVANCED OREBODY KNOWLEDGE

Any of the above programmes require a much better three-dimensional model of the ground in front of the mining faces, beyond just structure and grade. Therefore, new techniques are required to create these models so that mechanised mining systems can be planned for efficient, non-disruptive operations.

REAL-TIME INFORMATION SYSTEMS

Much research is required in the field of real-time information systems, digitisation and integrated communication technologies.

These areas of work relate to the "internet of things" in mining, and require specialised research into sensors, data capture, data transmission and data analysis and management in real time.

HUMAN FACTORS

None of these programmes will be successfully developed or implemented without a very good understanding and management of the human factors involved. These include issues of change management, skills development and behavioural aspects, all framed in the context of the 'just transition' to a sustainable economy, and decent work for local people.

2016 AREAS OF FOCUS continued

This non-explosive mining programme researches the means by which narrow-width mining can take place on a continuous basis, so that previously unexploitable reefs can be made economically viable. Research in this area started with a review of all previous and current attempts in this area, including the reef-boring project of AngloGold Ashanti. In parallel with this, researchers are being allocated to fundamental rock-breaking studies, with the involvement of local OEMs. This will result in 'local solutions for a local problem'.

There are three progammes which cut across all of these basic programmes:

- ***Advanced orebody knowledge:*** This programme recognises that significant capital investment into modernisation cannot be justified unless the orebody is de-risked. The aim of this programme is to develop real-time three dimensional models of structure, grade and other characteristics. Three researchers have already been assigned to the programme, with test sites established. Additionally, two international research studies identified through an Open Innovation Challenge done in collaboration with the Gauteng Innovation Hub, are under evaluation.
- ***Real time information management systems*** focuses on the "internet of things" or digitisation in mining. To assess the status of this in South African mines compared to global leading practice, two baseline studies have been commissioned through an international company. The steering committee has identified 13 work streams for research, and research institutions have been invited to participate in these streams. Essentially, this includes data collection, data transfer, spatial positioning, data standards and data conversion to management information, all in real time.
- ***Human factors*** is a programme that considers all of the change management and skills development areas associated with the 'just transition' to more modern mining methods, systems and mines. 'Just transition' is a framework that encompasses a range of social interventions needed to secure jobs and livelihoods, when economies are shifting to sustainable production. A steering committee is being established to guide the process, including creating a wider level of expertise in this area.

The Chamber provided financing for the immediate appointment of two programme managers, in the areas of modernisation and real-time information systems. Other programme managers will be appointed after the start of government's next financial year. Interim governance structures for the management of government funds are being established. Research institutions are in the process of submitting joint research proposals for the different programmes.

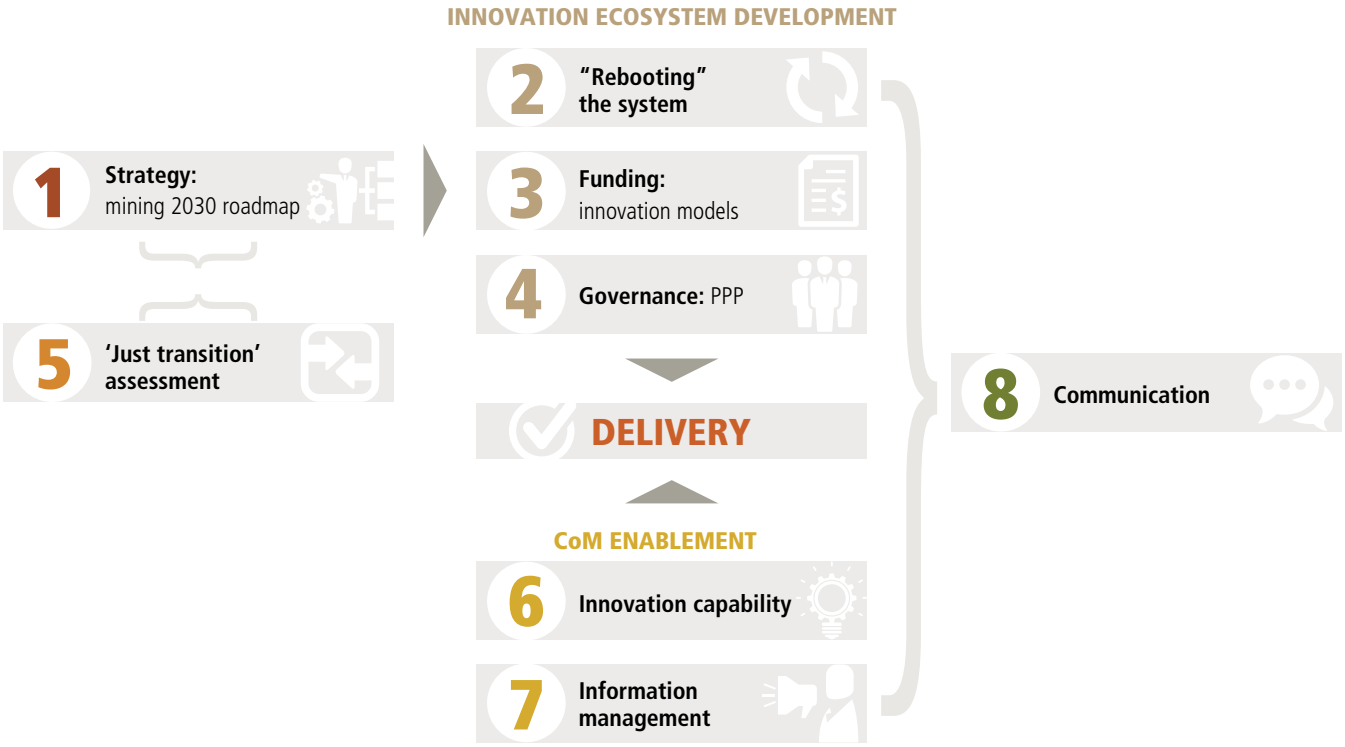
IMAGE

Exxaro is one of the largest black-owned, South African-based diversified resources companies

Modernisation continued

MINING 2030 THROUGH AN INNOVATION-FOCUSSED STRATEGY

Chamber Vice-President, Neal Froneman, in a presentation at the Mining Indaba said in Cape Town in February 2017, "To be successful, introducing technology will need to be addressed in a holistic manner, adopting a systems and people-centric approach." To give effect to a holistic approach to innovation the Chamber decided, as part of its annual strategic review, to develop an 'innovation-focused' strategy. The framework for such a strategy is in the diagram below.



IMAGE

Anglo American's coal business in South Africa produces thermal coal largely for domestic use

2016 AREAS OF FOCUS continued

The priorities for 2017 are:

- ***2030 mining innovation roadmap:*** Mining companies are the end-users of innovations aimed at addressing all the challenges that face them, from technical, safety, health and skills development to the environment and societal expectations. The aim of the 2030 Mining Innovation Roadmap is to provide direction to all those involved in mining innovation, including mining companies, suppliers of goods and services, research and development entities, government, funding agencies, etc. Research and stakeholder engagement will be undertaken on trends, scenarios and decision points around technology, society, regulations and innovation. The roadmap should provide a holistic view of the many possible futures of South African mining, together with the decision points that could enable the country's mining to choose 'better' futures.
- ***'Rebooting' the mining innovation ecosystem:*** South Africa used to be considered among the global leaders in mining innovation, but this is no longer the case. The question is whether the mining innovation ecosystem is 'broken' or lacks visibility to mining companies. Assuming it is the latter, the aim of this initiative is to illustrate to mining companies what South African entities can do through innovation to help them deal with the difficulties they encounter. We often come across new challenges in companies, solutions to which lie in the mining industry. By mapping existing ecosystem efforts, designing to enhance what exists and then generating interest through events, the intent is to develop a comprehensive understanding of the mining innovation ecosystem across South Africa, together with a means to activate that ecosystem to be fully effective.
- ***Funding and governance models:*** The main aim of this project is to provide guidance on possible public-private partnership funding and governance models that will accelerate mining innovation in a holistic manner.
- ***'Just transition':*** As part of a people-centric approach to introducing technology and other forms of innovation, the transition to modernised mining needs to be just and socially acceptable. The impacts of innovation need to be communicated by parties that enjoy credibility among all stakeholders and then be addressed in a holistic manner. The Chamber will participate in all efforts aimed at achieving this outcome.

IMAGE

Sibanye's Kroondal exploits the UG2 Reef on the western limb of the Bushveld Complex

IMAGE

AngloGold Ashanti's Mponeng mine is one of the world's richest gold mines

CASE STUDY

MODERNISATION OF THE GOLD INDUSTRY

There can be no denying the fact that South Africa's mining future lies in widespread and diverse mechanisation. The country's underground gold and platinum mines with their narrow reefs, increasing depths, steep ore, rising temperature gradients, abrasive rocks and increasing seismic challenges are – and have been since their inception – labour intensive. But if the country's remaining and extensive gold reserves can only be exploited at depths beyond those that can currently be worked by humans, new technologies have to be introduced for the mines of the future.

As our mines have aged, distances between working faces and shafts have risen inexorably, meaning that miners' travelling times to their workplaces have risen steadily, leaving less time available for work at the mine face. The effects on productivity and costs are clear, as are the effects on miners' health and safety.

Further, the industry's absolute objective is for zero harm. To this is linked the aim of improving productivity by allowing operations to be carried out on a 24/7 basis by 2025, in part through the introduction of remotely-controlled equipment that minimises or eliminates the need for human intervention at the working faces. Such mechanisation needs to take into account the different geologies and needs of the country's gold and platinum mines.

While many modernisation initiatives are being pursued by individual Chamber members to manage their mines' specific technical challenges, it is clear that a holistic, collaborative and cooperative approach can provide significant advantages. This process gained momentum over the past year with the Chamber's co-creation of a research, manufacturing and sustainability hub driven by dedicated industry specialists which brings together contributions from the country's universities, technical research institutions, equipment manufacturers, mining companies themselves and key state departments.

It is certain that significant expenditure will be needed for research into appropriate robust technologies over the next few decades. Funding by the state and by industry will be crucial. In addition, interventions will need to be ones that do not unnecessarily disrupt current conventional mining operations. The introduction of new technologies and equipment will be progressive – a process that will include the training of employees to operate the new equipment.

The Chamber is confident that the industry will rise to the challenges of modernisation.

CASE STUDY

SIBANYE'S DIGITAL JOURNEY

In identifying and promoting leading practice related to innovation, the Chamber of Mines engaged a number of companies on the role of technology and digital in the South African mining sector. As a result of this initiative, Sibanye conducted a Mining Innovation and Digital Assessment (MIDA), with the assistance of management consultancy McKinsey and Company to create a baseline for what is possible in the South African context.

In its focus on how digital innovation can improve mining productivity, McKinsey notes four factors for accelerating digital adoption:

- Data and computational power have all accelerated in size, speed and cost effectiveness over the last three to four years.
- Advanced analytics (machine learning, advanced statistics) help turn vast data sets into insights.
- Mobile devices have transformed the way people interact not only with one another, but also with machines. This enables process digitisation.
- The cost of industrial automation has fallen by 50% since 1990.

Sibanye aims to capitalise on the rapid progression of digital technologies by leveraging existing data within its operations through the adoption of advanced analytics and new technology. While the company continues to drive traditional performance improvements in safety and health, productivity, quality and cost, the inclusion of digital and new technology will enhance the company's ability to transform data into business intelligence and implement improvement initiatives more effectively. Digital insights may enable more effective mineral resource management, improve safety and health, create employment in a local, high technology design and manufacturing industry, support more vibrant economies in local host communities and deliver enhanced shareholder returns.

Some of the useful insights at Sibanye were:

- Vast amounts of data are generated across the business, with strong systems and standardised data collection across the supply chain. There is also a high level of integration across systems.
- The company generates basic insights, but there is an opportunity to leverage more advanced analyses to further optimise performance using the data currently generated.
- The company has a large, untapped data pool with which to improve performance.
- These opportunities indicated that the company could drive value immediately, without major upfront investment.

Sibanye's journey began with a number of activities including:

- Leveraging data that already generated in rail-bound equipment (RBE) and trackless mobile machinery (TMM).
- Developing applications to improve transparency and decision-making for employees.
- Launching partnerships with key players (OEMs, academics) to develop new technologies.

By leveraging data from safety systems on both TMMs and RBEs, Sibanye's Safe Technology department was able to develop substantial safety and asset optimisation improvements. The safety systems inform TMM operators of other personnel within their vicinity thus preventing collisions, while on RBE, the systems provide for proximity detection, as well as communication between the locomotive operator and guard. Both systems require event data logging for investigation in the event of an incident.

The TMM Proximity Detection System records the number of infringements in the asset's danger zone and the details of the employee who has infringed. The company was therefore able to use the data as a coaching tool to close gaps in training, and educate employees on the dangers associated with mobile machinery. Recorded infringements in the machinery danger zone were reduced significantly.

When analysing the information derived from the RBE proximity detection and communication system, management is able to view large variances in overall equipment efficiency on specific locomotives and levels. This may be as a result of the asset being used for either people or material transport, or ore transfer.

As locomotives are serviced weekly, fleet optimisation and the implementation of variable asset allocation will ensure that locomotives are used equally, improving the efficacy of weekly services and reducing downtime. Next, once a suitable amount of data is analysed, locomotive health profiles can be developed, facilitating the transition from preventative to predictive maintenance.

Sibanye currently operates more than 700 trackless mobile machines and over 1,000 locomotives. So, the optimisation of its fleet could provide Sibanye significant safety and cost improvement benefits with very little investment.