

From real-time monitoring to predictive intelligence

Christo Visagie, Director at BBE Group, talks about how advances in digital technologies are transforming the operation of mine ventilation and cooling systems, integrating real-time air quality monitoring with historical ventilation data to enable faster and more informed decision-making.

As South Africa's mining sector faces growing pressure to improve safety, efficiency, and environmental performance, mine ventilation and cooling remain critical levers for progress.

Rapid advances in sensors, data analytics, Artificial Intelligence (AI) and machine learning are making mine ventilation and cooling more dynamic and predictive. These tools enable mines to create responsive systems that adapt in real time to underground conditions.

Real-time air quality monitoring uses sensors to continuously track conditions such as airflow, gas concentrations, temperature and dust levels. This enables ventilation systems to respond based on predicted outcomes, thereby maintaining air quality compliance and ensuring worker safety.

Beyond real-time decision-making, these insights also contribute to building data on historical trends that feed into predictive ventilation control systems. By understanding past patterns, mines can forecast future ventilation needs more accurately and simulate the effects of system adjustments before making them.

Without insight into how a ventilation system will respond to control system changes over the next five minutes or the next twelve hours, mines risk making adjustments that could have unintended, even catastrophic, consequences. It can also lead to serious air availability issues and costly production losses. Predictive models help avoid this by simulating control system changes

in advance, allowing teams to assess outcomes before implementation.

Shifting from reactive to proactive ventilation management

Advanced data-driven ventilation modelling enables the accurate forecasting of underground airflow and temperature requirements, optimising airflow in active working areas while avoiding over- or under-ventilation to maintain safe working conditions. When combined with real-time monitoring, predictive control tools enable mines to dynamically adjust ventilation, enhancing energy efficiency, improving air quality and increasing worker comfort. This shifts from the historic trend of reactive ventilation management to proactive management.

In the past, a poor ventilation decision could take hours to correct. Now, predictive tools allow ventilation teams to simulate changes in a calibrated model, confirm outcomes instantly, and only implement adjustments that deliver desirable results, thus eliminating guesswork and delays.

VUMA Live: enabling safer, smarter mining

As a global leader in mine ventilation and cooling, BBE Group's VUMA-live software brings together historical and live data for immediate risk analysis and rapid response to changing underground conditions. It also enables mines to simulate scenarios, forecast risks and implement preventative control measures, allowing faster, smarter decisions and

accurate future planning.

"Having the right information and knowing exactly what's happening underground is essential," says Christo Visagie, Director at BBE Group. "Quick wins often come from simply surveying the mine and building and calibrating a ventilation model with tools like VUMA-network. Digital technologies play a critical role in supporting faster and smarter decision-making that ultimately leads to healthier working environments and improved production."

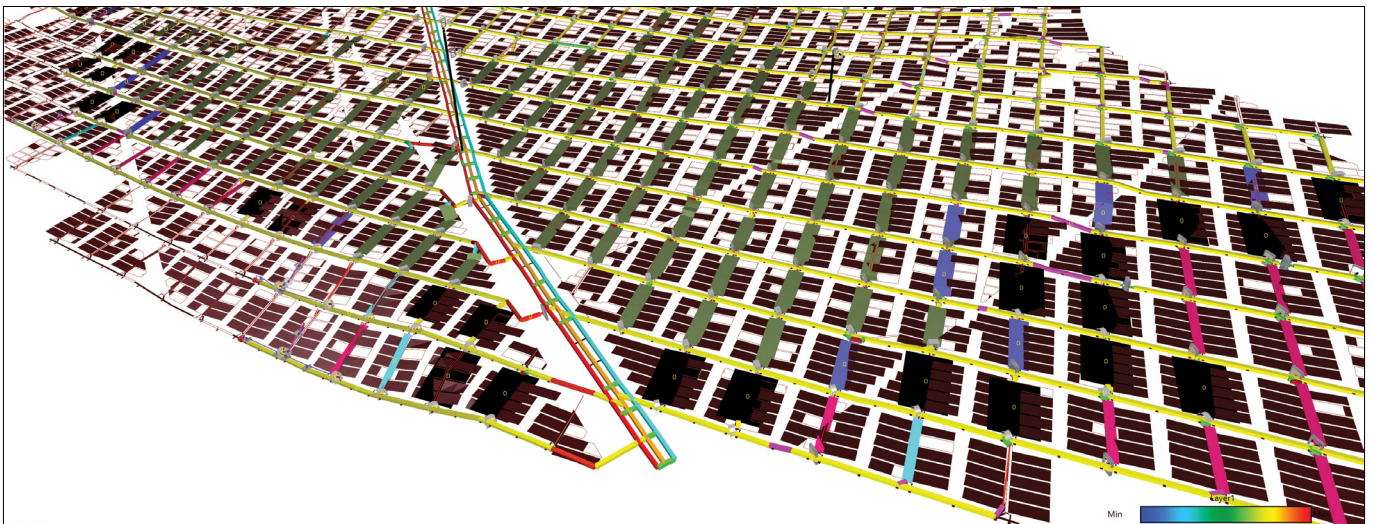
Scalable, future-ready solutions

Predictive ventilation systems are often seen as prohibitively expensive, but Visagie explains: "Long-term benefits like improved energy management and increased ventilation availability offset initial cost. This boosts production potential and allows for additional underground activity within the mine."

For existing mining operations, intelligent ventilation solutions are scalable and can help bridge the gap between legacy infrastructure and next-generation advancements.

Highlighting this, Visagie says: "By installing real-time monitoring on primary ventilation in phases, even legacy mines can start understanding what their ventilation system is delivering or capable of doing. This insight enables smarter ventilation planning and helps future-proof South African mines for a safer, more sustainable future."

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