SEEQUENT

INSIGHTS PAPER

Beyond the Hype:
How technology can drive mining operations' performance

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Forward

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Today's mining operations need to be future focused if they are to meet the demand for rare earth metals and minerals.

The only way the industry can hope to meet this growing demand is by optimising its operations — a task which will become ever-more complex as the pressure to perform increases. Pieter Neethling, Segment Director, Mining Operations, Seequent emphasizes, 'The subsurface is incredibly complex with many unknowns, yet critical decisions must still be made in the face of this uncertainty'. The mining industry needs to implement technology change now to ensure the sustainable and efficient running of operations today and into the future.

This paper examines how new technology is being developed and deployed to make mining operations safer, smarter and more cost effective. Seequent brought together key industry players for a forum hosted by Emily King, the Founder and CEO of Prospector, and attended by a panel of industry thought leaders from AngloGold Ashanti, Hecla Mining, IntelliSense.io, and RockMass Technologies, journalists from the mining press, and Seequent's industry experts.

The expert
contributors panel

Matt Blattman
Director Technical
Services, Hecla Mining

Alex Boucher
Technical Solutions
Director, Seequent

Marcelo Godoy
Chief Technology Officer,
AngloGold Ashanti

Emily King
Founder and CEO,
Prospector

Dr. Grant Kopec
VP Global Field
Operations, IntelliSense.io

Shelby Yee
Founder and CEO,
RockMass Technologies

Accurate data
must be harnessed

Grant Kopec
VP of Global Field Operations, IntelliSense.io

Data is at the heart of modern mining and its use is critical to its smooth operation. However, there are many challenges with its application – should everything start with the data or should data simply be 'used' to deliver a desired outcome? Our expert panel strongly believes that industry leaders must know precisely the goals they want to reach, the ROI they want to achieve, and the solution options that are available to them to reach those goals. Finally, they must consider the data requirements that will drive the solution.

Dr. Grant Kopec, VP of Global Field Operations for IntelliSense.io, comments, 'Simple things such as the placement of sensors at particular sampling locations make all the difference in predicting performance. Our experience is to look at the use case and then apply the data capture to drive the solution. This requires working very closely with the miners, their data analytics teams, the individual operational sites, and different vendors to make sure we all have the same data model, the same definitions, and that we're fixing data issues at the root source. This approach can also deliver secondary benefits. One such simple example is removing inconsistencies in the labelling of stockpiles and their boundaries, where we use the data to provide clarity.

The application of geological data is fundamental as mining companies build their models upon this and use them for crucial decision making. The raw data is transformed through software to create the models which can be used to ascertain the viability of a face and the deposits it contains.

Without the very latest geological data, the model will be flawed and could compromise the cost of extraction and the safety of the operation.

Detailed mine modelling
will improve performance

Alex Boucher
Technical Solutions Director, Seequent

Mining operational decisions critically rest upon a good model of the subsurface featuring geology and/or grades. Future models of geology must be easy to create, be repeatable and respond to the demand of the operational decision-making process. However, subsurface modelling has intrinsic uncertainty and subjectivity that are not common in other engineering fields.

Alex Boucher, Technical Solutions Director at Seequent, comments 'One of the main mining issues is that we currently make critical decisions, both strategic and tactical, using uncertain information. We can build several scenarios to capture the uncertainty, but we need to adapt workflows to process and analyse all of that information.'

To connect the geological modelling with the operations, Seequent is developing a flexible cloud-based ecosystem of solutions connected through seamless integrations.

Within this open environment, mining companies will be able to bring together data, services, and applications in real time. With access to the latest geological data and block models, operations will have the right information for a given decision; that is models that reflect the state of the drilling information and capture the geologist's confidence in that model.

Better use of geological models and block models leads to better operational performance.
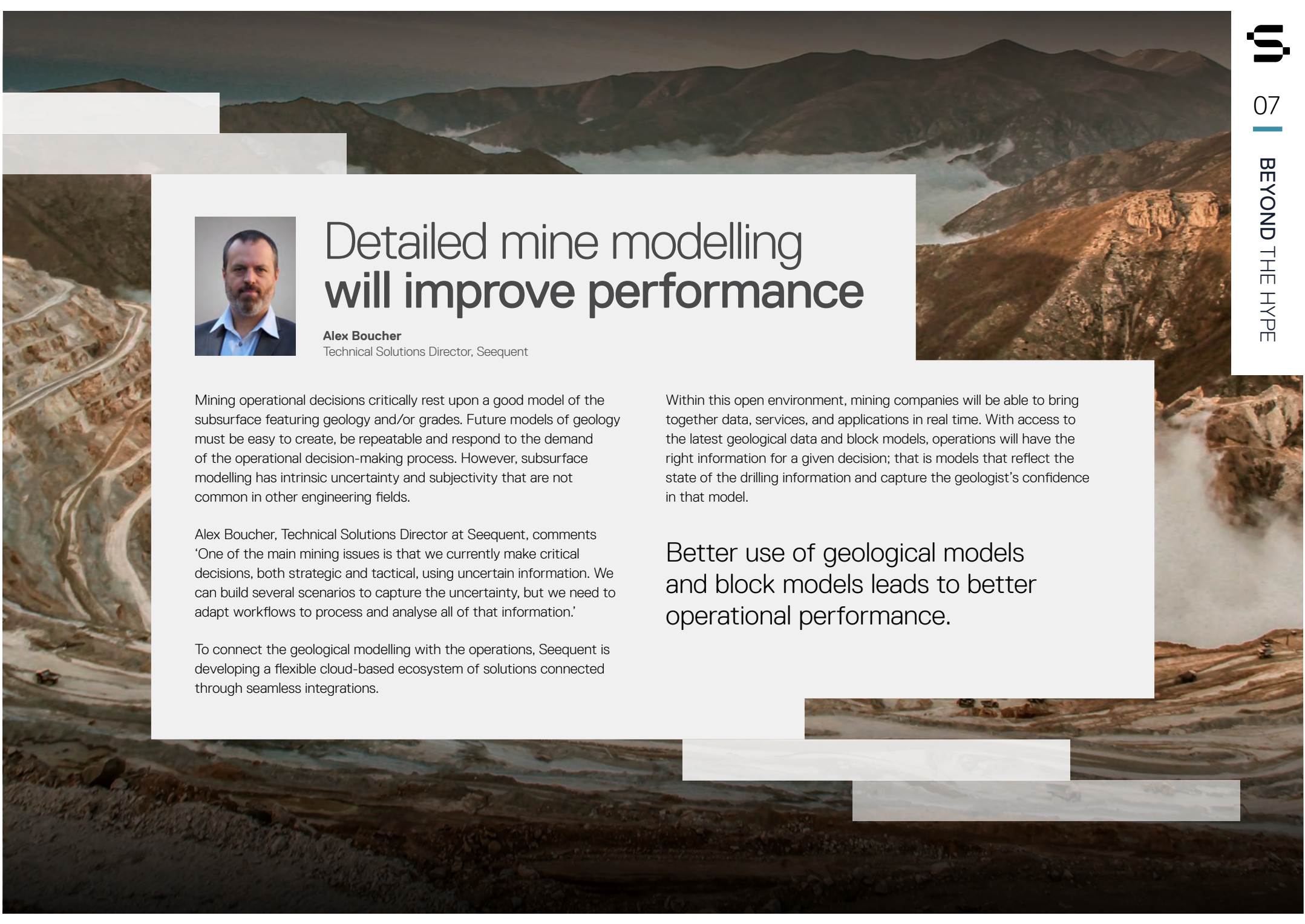
Integrating new digital workflows **can be challenging**

Matt Blattman
Director, Technical Services, Hecla Mining

A major challenge for the sector is also the application of new digital workflows as companies are having to purchase technology from several different vendors and frequently, these are not entirely compatible with each other.

There needs to be more standardisation across the industry.

Matt Blattman, Director of Technical Services, Hecla Mining, expands, 'We'd like to standardise, but within our own company, with four different mines, four different types of deposits and four different mining methods, it's hard to find something that fits every situation.'

Dr. Grant Kopec adds, 'The stickiness of new workflows is something that we're constantly challenged by. One of the things that kicks people out of a new workflow and back into the old one is a data quality or a data outage issue where they say, see it's not working or it's inaccurate, so I'm going back to my old way of working. That's something we've found to be a real challenge and requires transparency in the software and personal interaction to keep that trust which takes weeks, months or years to build.'

The new wave of technology
will revolutionise the industry

Shelby Yee
CEO, RockMass

Recent technological developments such as the FaceCapture™ mine mapping software system are delivering significant savings and additional benefits to the industry. In its drive to improve safety, Hecla Mining partnered with Mine Vision Systems to introduce the mapping system into two of its mines in North America. This system enables Hecla to map and geo-reference the mine face in real time, reduce production downtime by minimising the amount of time needed to map and document the face, and bring higher quality information to its geologists at the precise moment they need it most.

The system generates LiDAR scans of the underground excavations and can create 3D, high resolution, georeferenced images of those workings. The data comes out as industry standard files that are virtually software agnostic, thus improving their usage in all the mine departments. Hecla Mining is working to implement this technology in the surface operations and to merge the data with standard drone derived scans to get extremely accurate face profiles and structural data.

This new data improves blasting fragmentation, allows better grade control, cuts costs, increases productivity and improves safety.

Matt Blattman says, 'We wanted to remove our geologists from the face and from areas of dangerous underground seismic activity and so we worked with technology providers to build something that could do that. In this case, the geologists are provided with backpack mounted LiDAR units that can scan and geo-reference themselves underground and capture 3D photos of the face. If you have something that's safety driven, then I think that you have more incentive for the management team to implement it.'

RockMass Technologies' new RockMass Eon offers a similar solution in a handheld LiDAR solution for geotechnical and geological mapping. Shelby Yee, CEO of RockMass Technologies adds, 'We work with our clients to ensure that the data is easy for the end user to capture and usable by the modeler to make their decisions on a daily or a weekly basis. An example is when we worked with a narrow vein gold mining company that was face mapping on a regular basis and wanted to improve their block modelling. We worked to incorporate accurate, high-fidelity coloured 3D point clouds in real time - the first time we demonstrated it to them, the whole tech services team was astounded by what technology could now make possible.'

Creating
real change

Marcelo Godoy
Chief Technology Officer, AngloGold Ashanti

Many underground sites have health and safety challenges relating to security and the difficulty in hiring mine workers that have the necessary skills to work safely in a demanding and space restricted environment.

Additionally, all mining companies must reach net zero emissions by 2050, with substantial reductions by 2030. This makes the industry extremely receptive to the many benefits emerging technologies can offer.

AngloGold Ashanti is at the forefront of taking advantage of the new and emerging technologies and is using a wide range of applications:

- Electric Vehicles – the use of EVs reduces ventilation requirements in mines due to significant reduction in the generation of diesel particles and heat.

- Renewable energy integration increases solar or wind power across mining operations.

- The Internet of Things – IoT devices and sensors collect real-time data on equipment, environmental conditions, and worker's location. This data is used to improve operational efficiencies, optimise maintenance schedules, and enhance safety.

- Virtual Reality applied to safety training allows miners to practice the identification of major hazards in a virtual environment and gain valuable experience before entering hazardous working areas.

- Advanced Robotics – autonomous drill rigs in an open pit deliver improvements in efficiency, precision, and safety.

- Autonomous haulage systems – self-driving trucks and ancillary vehicles optimise operational efficiency and reduce the risk of accidents.

- Unmanned Aerial Vehicles (UAVs) are used to survey underground voids, do site security monitoring and geotechnical inspections.

- Advanced TSF remote monitoring – remote monitoring systems enable real-time monitoring of tailings storage facilities from a centralised control room. This allows for proactive tailings deposition and water management and is key to emergency preparedness planning.

Marcelo Godoy, Chief Technology Officer at AngloGold Ashanti, explains the technologies that his company is investing in, 'The focus of our new technology acquisition is electric vehicles. The use of EVs in underground mines is seen as a great step forward because it reduces ventilation requirements due to the significant reduction in diesel particulate matter and heat. The technology is not yet where we would like it to be, but it is a constantly evolving field, and we are currently running a trial in one of our mines in Brazil. Advanced robotics and autonomous systems also open huge possibilities, and I have no doubt that by the time we reach net zero emissions in 2050, our mines will be run by robots. Lastly, renewable energy integration will decrease emissions and lower our energy costs.'

The challenge of EVs in mines

As Marcelo Godoy hints at, the adoption of new technologies is not without issues. Electric vehicles have real limitations in terms of power output when compared to traditional diesel systems and their restricted battery capacity means they have a more limited range and run time, which necessitates frequent recharging or battery swapping. Mining haulage systems using EVs currently cannot operate for a full shift as after approximately two runs of a ramp they need to come back and swap their batteries. In addition, batteries add considerable weight and this impacts upon a vehicle's payload capacity and maneuverability in the restricted space environment of an underground mine. The implementation of an EV system requires new infrastructure to support the charging and swapping of batteries.

Electric vehicles are offering improvements, but real advancements in battery technology are what will make a real difference to both operations and environmental impact.

Matt Blattman comments, 'There are certain applications that could make sense in our Lucky Friday mine, which is deep and hot, with a significant amount of that heat coming from our diesel equipment. A battery system is a great idea because it could lead to the reduction of heat. The implementation of batteries is a different driver to economics as it's driven by the need for heat reduction and by the changes in infrastructure. The challenge is getting the new technology into the mine – how does one take a lithium battery, cut it into parts to get it down the shaft and then put it back together? EV operations are a great idea, but I just don't think the concept is mature enough yet for us to be able to fully implement it now.'

Digital twinning and AI will enable a shift
towards agile mining operations

Digital twin technology can also profoundly change how mining sites work. A digital twin is a complete replica of a real-world system, a 3D software model where one can view every aspect of a mine's operation in real time.

Carefully tailored AI systems that can run digital twins and other systems provide an exciting future. These models will allow the user to model and simulate the behaviour of entire mining complexes.

They'll allow mine owners to optimise operations, predict failures and test different scenarios for improved decision making and will dramatically increase the ability to design new mines, as instead of having one or two potential designs, the system will generate thousands of different options.

Developing underground mine designs is a laborious and time-consuming task which requires the consideration of multiple parameters such as resource models, mining methods, equipment selection, capital and operating costs. There is a huge opportunity for software developers to add AI capabilities that would not only allow for more efficient generation of designs but for hundreds or thousands of scenarios to be created and evaluated with ease. This is key to determining the more efficient and cost-effective mine design for a given ore body. The same technology can be integrated into geological data analysis, resource modelling, stability analysis, environmental impact assessments and definition exploration targets.

Traditionally, mining companies operate on an annual planning cycle, however, the new hybrid of AI and digital twinning will deliver real-time updates that will allow for a swift response to the ever-changing conditions of mining operations.
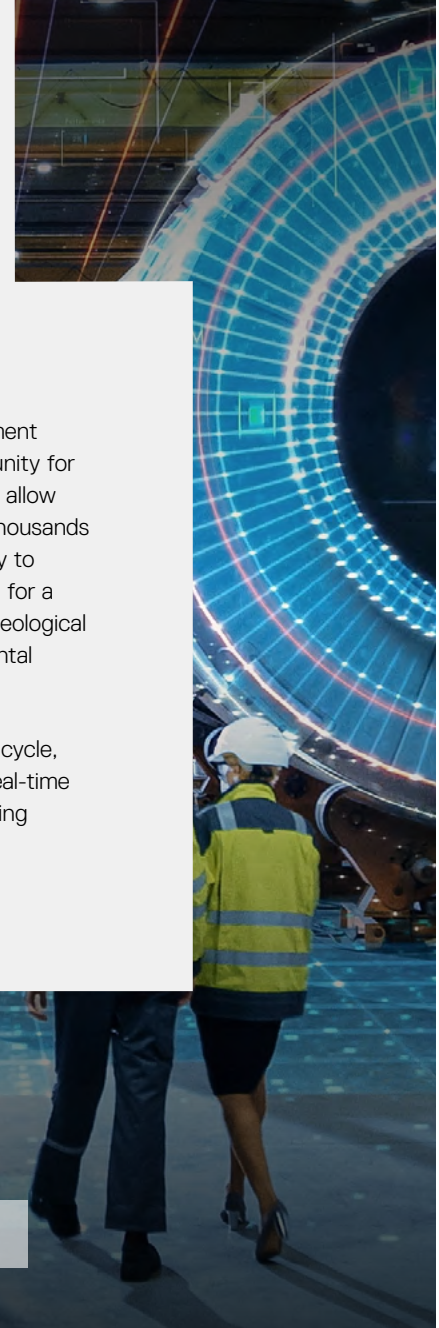
Implementing
new technology

The mining industry must decide who is going to figure out how to change the way it works. The service providers need to decide what the new tools will look like, but only the mining companies truly understand their operational issues and have the clear insight into the risks that are involved. Collaboration between all parties is key and the use of an open platform is an effective way to gather and harness the data.

While the potential of the emerging technologies is massive, their expense can present a challenge to investment. Many vendors come to the industry without a specific product and spend many months developing a bespoke solution, often at a high cost. The industry would benefit from readily accessible off-the-shelf products to enable it to swiftly reap the benefits of new technology.

Leveraging new technology to improve efficiency, safety and productivity in the face of strict investment criteria can be challenging.

The culture of risk avoidance in the industry and the drive for ROI can hamper investment in new technology. However, as crucial areas of the industry are currently unsustainable, companies are going to have to take a leap forward and develop new practices and adopt new innovations that will increase sustainability and improve performance.

Matt Blattman comments, 'We must look at the opportunities and decide where we can make an investment with the highest benefit to risk ratio. We should see if we can develop a proof of concept and then mitigate the risks as we go along. If you're just waiting for somebody to come in and solve everything for you, it's never going to happen, you've got to be looking for those opportunities. We need to learn from other industries in terms of our willingness to invest in research and development and we should see the necessary spending as an investment. The companies in our industry who do this are the ones who are going to find the new solutions.'

Conclusion

Mining operations are at one of the most important tipping points in their history. The push for rare earth metals and minerals is requiring ever greater outputs but greater performance needs to be achieved in a sustainable way that supports net zero goals.

New technology is essential if the industry is to improve the performance and safety standards while supporting the push for net zero. There are huge advances in technological development taking place now: AI continues to develop exponentially, and the use of LiDAR is expanding rapidly with the scanning system now being applied to drones, transport vehicles and technical services across the sector. This is being supported by the application of augmented and virtual reality which is driving substantial improvements in 3D modelling.

However, greater collaboration across the industry and with technology service providers is needed to create the right proofs of concept (PoC) and implement new systems that will improve every aspect of mining operations. New technology will harness the data and create the digital workflows and the 3D models that will enable the industry to operate more efficiently, more safely and with less environmental impact.

In this paper, key industry leaders are calling for higher investment in research and development to facilitate the innovation and integration of the new wave of technology into mining operations. The time for implementation is now to ensure the sustainable and efficient running of operations today and into the future.

Five key takeaway points
for mining executives

1. See net zero as a positive catalyst for driving change and improving long-term performance.

2. Secure investment by presenting the safety and sustainability benefits of new and emerging technologies.

3. Identify specific proofs of concept and implement new technologies by mitigating risk as you progress each PoC.

4. Consider bringing together data, services, and applications within an open environment to enable a better use of geological models.

5. Collaborate across the industry – share experiences to power change.

To learn more on the optimisation of mining operations, talk to us.

Seequent, The Bentley Subsurface Company