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REGIONAL FOCUS: CENTRAL AFRICA

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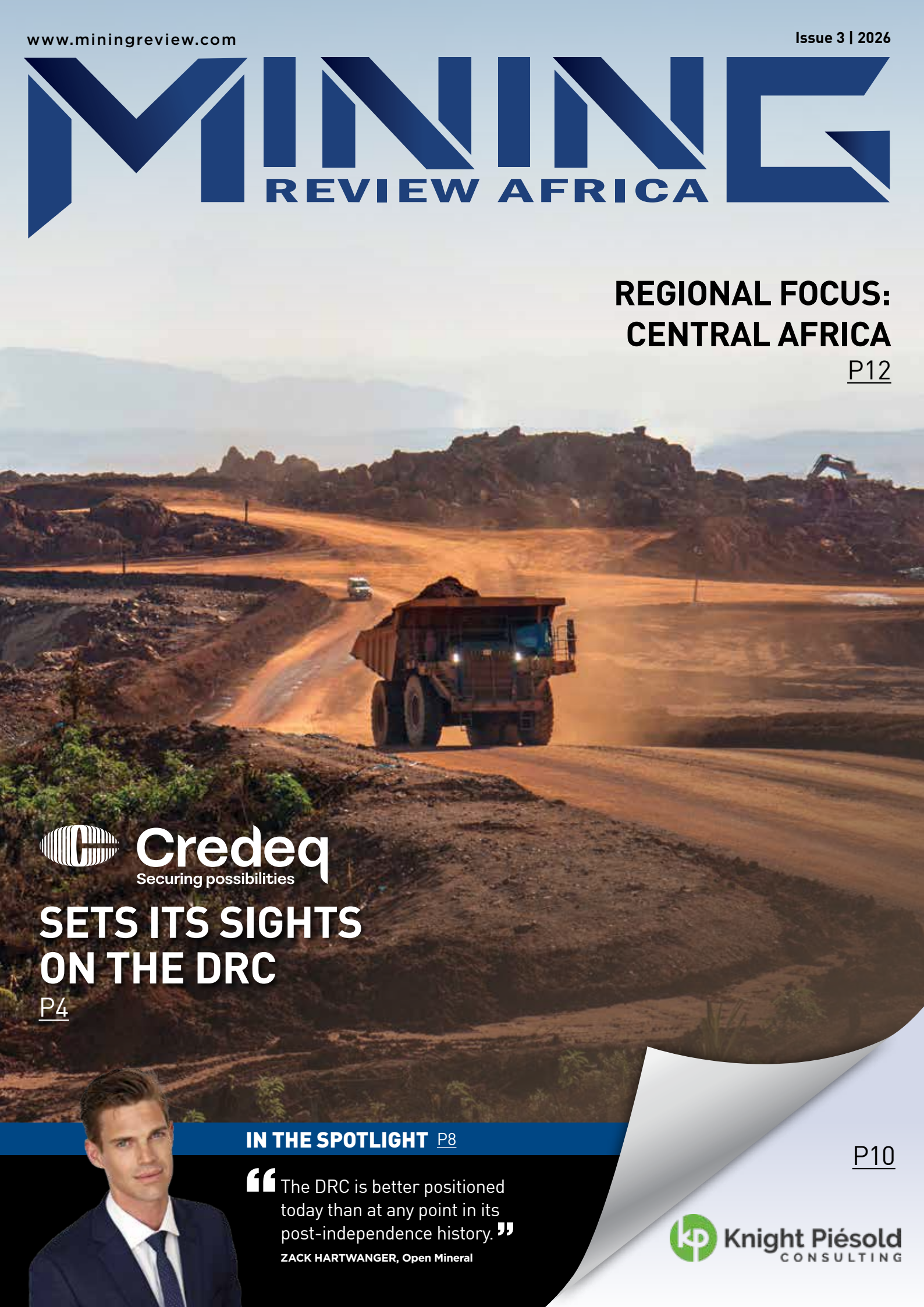

Credeq
Securing possibilities

SETS ITS SIGHTS ON THE DRC

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"The DRC is better positioned today than at any point in its post-independence history."

ZACK HARTWANGER, Open Mineral

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Knight Piésold CONSULTING

Building resilient mines

Knight Piésold's multidisciplinary engineering expertise

Mining's growing complexity is driving demand for integrated engineering solutions. From water management to predictive modelling, companies face pressure to ensure safe, sustainable, and efficient operations. **CONSTANCE SITHOLE** speaks to **EDOARDO ZANNONI**, technical director for mine services at **Knight Piésold Southern Africa**, on how modern challenges are breaking traditional engineering silos.

Engineering consulting firm Knight Piésold Southern Africa is positioning its Mine Services division at the centre of this shift by offering a multidisciplinary approach that integrates engineering, sustainability and operational considerations throughout the entire life of a mining project.

According to Zannoni, modern mining challenges require fully integrated solutions.

"Mining operations are no longer isolated engineering problems," Zannoni explains. "They are complex systems where infrastructure, environmental conditions, water management and operational performance are deeply interconnected."

A 360-degree engineering perspective

Knight Piésold Southern Africa has been in operation for 105 years and today delivers engineering and consulting services to clients across the infrastructure, hydropower and mining sectors worldwide. In the mining industry, the firm's Mine Services division supports operations by providing integrated solutions that cover infrastructure development, geo-engineering, water management, and environmental compliance.

Rather than addressing each discipline independently, the company promotes a holistic engineering framework that considers the interaction between multiple components of a mining operation.

"In most projects there are two or more disciplines involved," Zannoni says. "Our role is to bring these together so our client can develop a strategy that addresses everything at the same time instead of moving from one silo to another."

This integrated approach enables mining companies to better understand how engineering decisions affect operational efficiency, environmental impact, and long-term costs.

Infrastructure: the hidden driver of operational efficiency

One example where this multidisciplinary strategy delivers value is mine infrastructure – particularly haul roads.

While road construction often represents a relatively small portion of capital expenditure, maintenance can become a major cost driver for operations. Poorly maintained roads can also create a chain reaction of operational challenges.

"If roads are not properly maintained, the effects extend far beyond transportation," Zannoni explains. "Equipment suffers more wear and tear, tyres are replaced more frequently, operational costs increase as well as increased risk for losing control of machineries."

Knight Piésold Southern Africa works with mines to strengthen environmental compliance, improve water management and enhance engineering systems, supporting safer operations, better recovery and long-term sustainability

Environmental factors must also be considered. Dust generation and stormwater runoff from haul roads can affect surrounding communities and ecosystems if not properly managed.

By combining civil engineering, environmental analysis and operational data, Knight Piésold helps mining companies design and maintain road infrastructure that improves efficiency while reducing environmental impact.

Water management: managing both scarcity and excess

Water remains one of the most critical variables in mining operations, particularly across Africa where climatic conditions can vary dramatically between regions.

Knight Piésold Southern Africa's projects span environments ranging from arid regions such as Botswana and Namibia to high-rainfall areas like Zambia and the Democratic Republic of Congo (DRC). In both extremes, water represents a significant operational risk.

"In mining, both too much water and too little water can shut down operations," Zannoni notes. "Water management must be considered across the entire system – from groundwater to stormwater and plant processing requirements."

Uncontrolled groundwater inflows can destabilise open pits, flood underground workings, or require costly pumping operations. To address this, the company applies integrated hydrogeological modelling to evaluate how water moves through the ground and how it affects mine stability and production plans, liaising with the mining and processing side to provide the required water to operate.

In one example, Knight Piésold Southern Africa combined hydrogeological analysis with mine planning to demonstrate that a proposed mining sequence would eventually lead to excessive groundwater pumping requirements and potential pit instability. By integrating these disciplines early, the company helped the client adjust its strategy before costly operational disruptions occurred.

Predictive modelling and AI-driven decision support

Digital tools are also reshaping how mining infrastructure and environmental risks are managed.

Knight Piésold Southern Africa is increasingly using advanced modelling software and Artificial Intelligence (AI) tools to analyse large datasets and simulate operational scenarios. These systems can incorporate hundreds of variables, including rainfall, groundwater levels and environmental conditions – to predict how a mining system will behave over time.

> "Mining operations are complex systems where infrastructure, environmental conditions, water management and operational performance are deeply interconnected."
>
> **EDOARDO ZANNONI**

Such predictive modelling allows engineers to identify potential risks and optimise design decisions long before they affect operations.

"What might take a team of engineers weeks to analyse manually can now be simulated in a matter of hours," says Zannoni. "These models help clients make more informed decisions because they can see multiple possible scenarios."

However, Zannoni emphasises that digital tools must still be combined with engineering oversight and thorough control of input information.

"Data models are powerful, but they require proper stress testing and validation. Engineering judgement remains essential."

Preparing mines for climate change

Climate variability is another factor increasingly shaping mine infrastructure design.

Across Africa, rainfall patterns are becoming more unpredictable, with intense storms occurring over shorter time periods. This can overwhelm infrastructure designed for historical rainfall patterns.

"The key challenge today is not just the quantity of rain falling, but the recurring series of rainfall over a short time," Zannoni explains. "You might receive the same annual rainfall but it's concentrated within a few hours rather than spread across months."

This shift requires new approaches to stormwater management, water storage, and infrastructure design to ensure mining operations remain resilient under extreme weather conditions.

The future of mine services

Looking ahead, multidisciplinary collaboration, data integration and automation are expected to shape the next phase of mining engineering.

As operations become increasingly data-driven, engineering firms will need to manage complex projects involving environmental, social, and governance considerations alongside traditional engineering design.

"The future of mining projects is multidisciplinary," Zannoni concludes. "Our goal is to navigate that complexity and deliver solutions that meet engineering, environmental and governance requirements at the same time."

For mining companies facing rising operational and environmental challenges, integrated engineering solutions may prove essential to maintaining safe, efficient, and sustainable operations. MRA