



Revolutionising the education of mining engineers

The Department of Mining Engineering at the University of Pretoria has made giant strides in hybrid education models with the initiation of the Kumba Virtual Reality Centre for Mine Design. This centre marks the start of a new era in the education of students in mining engineering, graduates and practitioners, and has the potential to contribute significantly to the future of mining in South Africa and the rest of the world.

For the past three years, in partnership with Kumba Iron Ore, the Department of Mining Engineering has been hard at work developing the Kumba Virtual Reality Centre for Mine Design. This is the first centre of its kind in Africa, and enables a revolutionary way of educating students and mine staff in a simulated mining environment. The centre is the product of a R18.8 million corporate social responsibility sponsorship from Kumba Iron Ore, and has been in full operation since its launch in August 2015.

The Kumba Virtual Reality Centre for Mine Design comprises three sections, each designed and developed with the aim of providing students in mining engineering with a realistic and immersive experience of the possibilities, limitations and challenges of mine design; not only from a research perspective, but also in industry.

The first section of the centre comprises a computer-assisted lecture hall where students learn about mine design and apply their newly acquired skills to their own mine design projects.



The Kumba Virtual Reality Centre for Mine Design simulates high-risk scenarios in a safe and controlled environment.

The second section comprises a wall-to-wall 3D theatre, where student mine designs and other teaching resources can be showcased so that students can learn through a visual process. The final section of the centre provides an immersive experience, and comprises a theatre with 360° floor-to-ceiling screens inside which the virtual reality simulator casts

images against the dark surrounding panels with cinematic clarity and highly realistic sound effects.

The core motivation behind the Kumba Virtual Reality Centre for Mine Design stems from Kumba's belief that all mining injuries are preventable and that much can be done in South Africa to achieve the "zero-harm" objective that is embraced by mining companies. As such, the benefactor is eager to see what can be achieved through its collaboration with the University of Pretoria, which Norman Mbazima, CEO of Kumba Iron Ore, describes as a credible partner, in realising the potential of these technological innovations.

The appeal of the centre is based on it being a low-risk, high-impact learning environment. "The Kumba Virtual Reality Centre for Mine Design simulates high-risk scenarios in a safe and controlled environment where the consequences of any unsafe act can be powerfully demonstrated without causing any actual loss of life and damage to property," says Prof Ronny Webber-Youngman, Head of the Department of Mining Engineering.



→ *Guests at the launch of the Kumba Virtual Reality Centre for Mine Design participate in the immersive experience.*

Institutional and industry collaboration

Together with the establishment of the Kumba Virtual Reality Centre for Mine Design, the Department has also established the Mining Resilience Research Institute (MRRI). This was prompted by the realisation that, for a number of complex reasons, mining in South Africa is not meeting the full expectations of all stakeholders.

Through the MRRI, which also forms part of the existing Sasol Chair in Safety, Health and Environment, the University has the potential to establish itself as a leading international contributor to solutions for complex mining industry problems through the rigorous integration of scientific research, the pursuit of practically implementable

solutions and the education of graduates who are equipped with relevant skills.

The Kumba Virtual Reality Centre for Mine Design, through its utilisation of cutting-edge virtual reality technology, is capable of contributing to such research and teaching in a unique way. In practice, undergraduate students in mining engineering can integrate different conceptual and software modelling techniques, which incorporate geological models, mineral extraction methods, mine planning and design, and mining systems in a virtual reality environment.

This allows them to design a complex mining operation and virtually study its life cycle by actually seeing the long-term visual and environmental

consequences of their financial and technical decisions. In addition, the centre allows for the reconstruction of mining incidents for forensic investigation purposes, and allows for the reverse engineering of mine structures to prevent dangerous incidents from occurring in future.

By improving the ability of mining engineers to take these factors into account, the centre has the ability to provide significant economic, environmental and safety benefits to the industry and the communities affected by mining operations in the real world, and thus contributes to society on various levels.

In addition to the very real benefits that the Kumba Virtual Reality Centre for Mine Design holds for the South African mining

industry, its establishment also highlights the benefits of institutional and industry collaboration when it comes to solving pressing problems.

The centre is an embodiment of collaborative efforts between various disciplines. Most significantly, it emphasises the power of big data collected and collated on a large scale to find ways of addressing real problems and inform learning and practice in various industries. Prof Webber-Youngman advocated for implementing the lessons learned through the Kumba Virtual Reality Centre for Mine Design to other industries by integrating other fields of study into the virtual world of the centre.

As an expression of these institutional goals, the Faculty of Engineering,



→ Celebrating the official opening of the Kumba Virtual Reality Centre for Mine Design are (from left) Prof Sunil Maharaj, Dean of the Faculty of Engineering, Built Environment and Information Technology, Prof Cheryl de la Rey, Vice-Chancellor and Principal, Norman Mbazima, CEO of Kumba Iron Ore, and Prof Ronny Webber-Youngman, Head of the Department of Mining Engineering.

Built Environment and Information Technology realises that contributions to the knowledge economy from these research efforts require an essential step towards the “human economy”, or a serious investment in improving human capital. The Kumba Virtual Reality Centre for Mine Design is a platform designed to close the gap between study and industry by equipping students for the realities, challenges and dangers of mining; a testimony to the University’s efforts to ensure that it is not isolated from industry and that it is able to deliver graduates with relevant and implementable skills.

Ensuring relevance with a revolutionary hybrid teaching model

The Kumba Virtual Reality Centre for Mine Design signifies a huge leap in innovative

education and teaching in South Africa. This is an essential characteristic of institutions that strive for relevance both in academia and in industry, and is a core strategic goal of the University. The incorporation of virtual reality technology constitutes an essential supportive resource in the immersive teaching model adopted by the Department of Mining Engineering. Essentially, this hybrid teaching model brings to life the 3D structures and principles that students traditionally had to visualise from their 2D textbooks.

Engineering subjects are highly technical, and it is often difficult for students to visualise the concepts without actually seeing them. Students can now design their mining projects on computers and see their design decisions

realise in the 3D theatre where they can identify potential problems and see the effects of these problems in a simulated environment.

Prof Webber-Youngman calls the students who will participate in this teaching and learning platform “imagineers”, because they will become a new generation of engineers who will be able to imagine better solutions to real-world problems.

Both the 3D theatre and the immersive mine simulation theatre allow students to visualise practical elements of their subject content. This includes elements such as the relativity and size of objects, the visual texture of material and the effect of explosions. Here, they can see exactly where they will work and what they will do before even setting foot on a real mine.

However, Prof Webber-Youngman explains that the virtual reality experience is intended to supplement actual mine visits rather than replace exposure to real mines. Virtual reality can simulate the real mining environment, but it cannot replace the experience of the real situation.

The impact that this centre will have on research and teaching in mining engineering at the University of Pretoria and the country as a whole will be invaluable.

Its optimisation of information and visualisation has made great strides towards ensuring relevant education and learning for students, and has strengthened the ability of academic research to make a positive contribution to the industry in which it operates. ➔



→ Students experience the Kumba Virtual Reality Centre for Mine Design.

