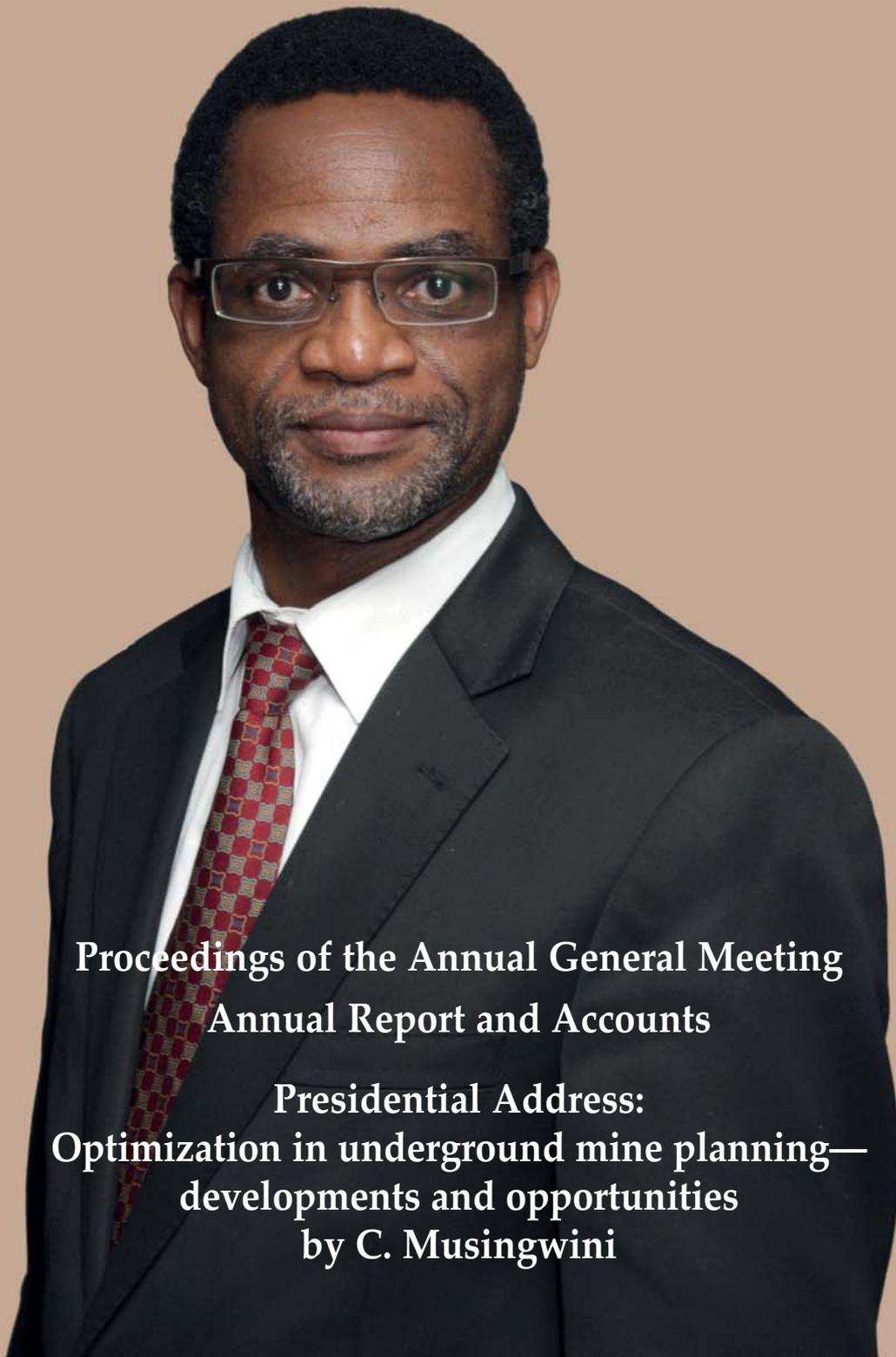




# SAIMM

JOURNAL OF THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY

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**Proceedings of the Annual General Meeting  
Annual Report and Accounts**

**Presidential Address:  
Optimization in underground mine planning—  
developments and opportunities  
by C. Musingwini**

# Introduction to our new President...

## CUTHBERT MUSINGWINI

Cuthbert Musingwini was born in 1968 in Murewa, Zimbabwe. He holds a BSc Honours degree in mining engineering from the University of Zimbabwe (UZ), and obtained MSc and PhD degrees in mining engineering from the University of the Witwatersrand (Wits). Cuthbert is a Fellow of the Southern African Institute of Mining and Metallurgy (SAIMM) and is a registered professional engineer with the Engineering Council of South Africa (ECSA). He is a member of the international Society of Mining Professors (SOMP). Cuthbert is a rated researcher with the National Research Foundation (NRF). He has over 20 years of mining engineering experience in mine production management and planning, consulting, and academia.

Cuthbert commenced his career as a graduate trainee with Lonrho Zimbabwe's Independence Gold Mining in 1991, and quickly rose through the production ranks as miner, shift boss, and mine captain. In 1996 he joined the German-funded GTZ-UZ Riverbed Mining Project as a research fellow, while concurrently studying for a part-time MSc degree in mining engineering at Wits. In 2000 he was appointed as a lecturer at UZ and became Head of Department in 2003. In 2004 Cuthbert emigrated to South Africa to join Wits as a lecturer. He completed his PhD in 2009 and was promoted to Senior Lecturer in 2010, Associate Professor in 2012, and full Professor in 2014. In 2015 Cuthbert was appointed as the Head of the School of Mining Engineering at Wits University, a position he holds to date. Cuthbert lectures at both undergraduate and postgraduate levels in Optimisation in Mine Planning and Mine Financial Valuation. He has supervised several MSc and PhD research students, and occasionally examines PhD theses in mine planning and valuation for the University of Queensland and Curtin University in Australia. Cuthbert has been a resource person on the Netherlands Initiative for Capacity Development in Higher Education (NICHE) for capacity-building projects at the University of Zambia's School of Mines and the Instituto Superior Politecnico de Tete (ISPT) in Mozambique. He was previously an associate consultant for two South African consulting companies specialising in mining business optimisation and valuation, MineQuest and Venmyn.

Cuthbert was elected to Council in 2011 and became an office bearer in 2013. He has served on the Mining TPC since 2008, the SAIMM's International Platinum Conference Organising Committee since 2010, and previously on the SAIMM Student Colloquium Organising Committee between 2010 and 2012. He has served on ECSA's Professional Advisory Committee (PAC) Mining Engineering since 2010 and ECSA's Engineering Programme Accreditation Committee (EPAC) since 2013. Cuthbert is a Managing Editor of the International Journal of Mining, Reclamation and Environment published by the Taylor and Francis Group in the UK, and has been on the Editorial Board of the Journal of the SAIMM since 2008. He has served on the International Organising Committee for the Mine Planning and Equipment Selection (MPES) conferences since 2012 and was the Chairperson of MPES 2015, which South Africa was privileged to host for the first time in the 25-year history of the conference.

There are some highlights worth sharing in Cuthbert's life, from his student days to the present day. In 1985 he completed O-Levels as the top student at Murewa High School, Zimbabwe. In 1991, Cuthbert was the first student to graduate with a first-class honours in mining engineering at the University of Zimbabwe since the establishment of the degree programme in 1985. He received the Arthur Bensusan Prize for being the top student in his class, and was a recipient of the Lonrho Zimbabwe Independence Gold Mining Scholarship. In 2010 he was awarded Wits University's Faculty of Engineering and the Built Environment (FEBE) Most Improved Researcher Award. In 2014 Cuthbert became the first black Honorary Treasurer for the SAIMM, the first black Full Professor of Mining Engineering in South Africa, and the first black NRF-rated researcher in mining engineering in South Africa. In 2015 Cuthbert became the first black Head of the School of Mining Engineering at Wits University and in South Africa.

Cuthbert is married to Grace (an alumna of Wits) and they are blessed with two wonderful children. Their son Shingirai, graduated with a BA Law degree from Wits in 2016 and is currently completing the remaining modules for an LLB degree. Their daughter Gamuchirai, is a first-year BBA student at Milpark Business School. Cuthbert owes his success to others who have opened doors for him and he is passionate about developing others. In his spare time, Cuthbert enjoys playing mind games but his 'to-do' list includes golf because he believes that 'work is for those who cannot play golf'. Most importantly, he is a Christ-follower and has served Aldersgate Methodist Church in Glenhazel as a Vestry Steward and Pew Bible reader since 2010. Cuthbert is grateful to the Lord for all the blessings in his life.



*Gamuchirai, Cuthbert, Grace, and Shingirai*



*In celebrating 120 years the School of Mining Engineering takes pleasure in congratulating and wishing*

### **Professor Cuthbert Musingwini**

*a successful tenure of office, as President of the SAIMM*

The School of Mining Engineering was founded as the School of Mines in 1896 in Kimberley. It moved to Johannesburg in 1904 and became the nucleus of the University of the Witwatersrand. This year 2016 the School celebrates 120 years which is a significant milestone in its history. Professor Musingwini's Presidency coincides with this special occasion.



Wits Mining has a symbiotic relationship with the long and illustrious history of the country's mining industry and the SAIMM. Wits Mining is in the top 100 of 403 mining schools worldwide, and number one among mining schools in South Africa. The School has four NRF-rated academics, an undergraduate degree programme accredited by the Engineering Council of South Africa (ECSA) and is the largest mining school in the English-speaking world.



The School's expertise lies in rock engineering, mineral economics, mineral resources management, mineral resources evaluation, mine planning and optimisation, mine ventilation, coal mining and health safety and environment. The School hosts two centres i.e. the Centre for Mechanised Mining Systems (CMMS) and Centre for Sustainability in Mining and Industry (CSMI).



The School has world class facilities which include a 100-seater Mine Design Laboratory, Digital Mine Tunnel and a well-equipped Rock Engineering Laboratory.

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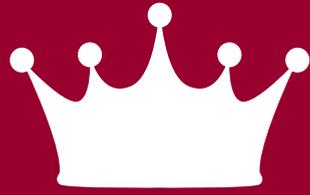
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**New Book Release**



## Theoretical Rock Mechanics for Professional Practice

by **Matthew Handley**

The planned rock mechanics textbook is a synthesis of 22 classic texts on rock mechanics, solid mechanics, the author's 15 years' experience in rock mechanics in the gold mining industry, and 10 years as a professor at the University of Pretoria (1984-2009). Throughout this period, the author noted that all the introductory texts on stress and strain were incomplete in one way or another, and that this, together with the watered-down introductions to stress and strain currently accepted in the mining rock mechanics fraternity, forms a barrier to the rest of rock mechanics.

This incompleteness in the classic texts was not the result of the omission of important material by any of the authors of these texts, but the result of the *assumed level of learning of the reader*. Readers with an advanced tertiary engineering background would understand the work whilst almost all others would struggle. Most texts, for example Biot (1965), Fung (1965), Jaeger and Cook (1979) and Brady and Brown (2006) all require, in differing proportions, a grounding in solid statics and dynamics, prior knowledge of the calculus, including partial differential equations, linear algebra, and tensor calculus, when introducing fundamental concepts such as stress and strain. A sampling of the texts consulted by the author appears below.

Such high-level introductions to stress and strain can never be informative to the uninitiated, and this is part of the reason why so many flounder in the rock mechanics certificate examinations, even when asked to perform simple calculations and interpretations. In order to make the theory accessible to all, these more complete dissertations on stress and strain were stripped of much of their content, and re-introduced in simplified form in a book edited by Budavari (1983). In this book, (which is not wrong in any of its essentials) the theory of stress and strain are reduced to the notion that stress is a vector, defined by force divided by area, whilst strain is a ratio of change in length of a body through deformation with respect to some original length. These notions while not essentially wrong, are so reduced with respect to the reality that no candidate can actually develop from them a proper understanding of what the quantities of stress and strain actually are, unless they are prepared to make the leap from this text and grapple with more advanced (and complete) texts on the subject. Furthermore, stresses and strains are then treated as scalar quantities in two dimensions, whereas a three-dimensional view is essential for any proper understanding of rockmass behaviour in a mine. Therefore, in the opinion of the author, the practice of rock mechanics has stagnated within a reduced two-dimensional view of what is very much at least a three-dimensional problem, for the last thirty to forty years.

In response to this observation, the author spent the last ten years developing more accessible texts on the fundamentals in rock mechanics, which were presented as lectures on rock mechanics to undergraduate mining engineering and geology students at the University of Pretoria. The litmus test of these texts was that the geology students made equally good progress as the engineering students, even though they had lesser mathematical backgrounds. This encourages the author to believe that the content of the book will be equally understandable to the uninitiated as the reduced texts such as those in Budavari (1983) were.

The price that the candidate has to pay is to develop a three-dimensional view of the forces, displacements, and hence stresses and strains that develop within rockmasses in mines, and to *understand* exactly what they are. The advantage is that the candidate will build a far clearer and deeper understanding of what is actually happening in a rock mass, and therefore will be far better equipped to understand the output of numerical

models, which are at least three-dimensional (static), and sometimes four-dimensional (dynamic). Candidates with this background will therefore be able to make the right interpretations of the model outputs, and ultimately, to draw the correct conclusions, which are direct inputs into subsequent decision-making. This will result in the advancement of the practice of rock engineering in the future, with the concomitant improvement in rock-related safety in mines, both shallow, and deep.

This book is not intended to supplant the learning material for the rock mechanics certificate that will be written for the MQA in the short- to medium-term. However, in accordance with the ninth ECSA exit level outcome: *Independent Learning Ability*, the learning texts for the rock mechanics certificate should provide a basis for life-long learning, and should therefore include a description on the fundamental theory of this nature, otherwise the transition to more advanced texts will be too difficult. Providing uninitiated candidates with watered-down concepts of the fundamentals of rock mechanics - as has been done in the past - will not only fail to do this, but will constitute a barrier to further learning by the candidate, and therefore lead to a permanent barrier to real progress in the engineering science of rock mechanics, as it is practised in the mines in South Africa.

### About the author

Matthew Handley has spent thirty-seven years in, or associated with, the mining industry in rock engineering, geology and engineering geology. Most of the first twenty-one years (1979-1999 inclusive) were spent between Western Deep Levels Gold Mine, the Chamber of Mines Research Organisation, the CSIR Division of Mining Technology, and postgraduate studies at the University of Minnesota, USA, developing a speciality in deep level mining rock mechanics and advanced numerical modelling techniques. The following decade (2000-2008 inclusive) consisted primarily of teaching undergraduate and post graduate courses in the Department of Mining Engineering at the University of Pretoria as Associate Professor of Rock Mechanics, and later as Professor of Rock Mechanics. The author left the University of Pretoria in November 2008 to write a book on theoretical rock mechanics for the tabular hard rock gold and platinum mines in South Africa, and to consult to the mining industry in South Africa on rock mechanics. The author lives with his wife and family in Pretoria.



## The Southern African Institute of Mining and Metallurgy

### Theoretical Rock Mechanics for Professional Practice by Matthew Handley

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## Democratic Republic of Congo Branch Susa Maleba

Susa Maleba graduated from the University of Lubumbashi, DRC, with a BSc Eng. (Mining) and completed a BSc (Hons) in Mining Engineering, specializing in Mining Environment, at Pretoria University. Susa has been involved in the field of mining engineering, specializing in mining design, mining ventilation, and mine planning, for the past 16 years. His expertise includes:

- Underground mine design, layout, and scheduling
- Mine ventilation and refrigeration, environmental control, and occupational hygiene
- Open pit design, optimization, and production scheduling
- Feasibility studies on open pit and underground operations
- Environmental and social research, impact assessment, stakeholder engagement
- Recruitment, training and coordination of mining-related personnel
- Consulting and contracting.

He is currently Country Manager/Mining Engineer for SRK Consulting in the DRC ◆



## Johannesburg Branch John Arthur Luckmann

John Arthur has been a Fellow of the SAIMM since 1989 and member of the Johannesburg branch committee since 2013. John was elected as Vice Chairman in 2014 and Branch Chairman in 2016. John currently serves on the Technical Programme Committee and the Publication Committee. John represents the Career Guidance and Education Committee on the YPC committee as an observer.

After graduating from the Silesian University of Technology in 1974, John started his career as an engineer in training at Biprol, Poland, then in 1980 John joined JF Thomson (Pty) Ltd a company based in Perth, Western Australia. In 1984 John teamed up with the Chamber of Mines Research Organization of South Africa (COMRO).

In 1990 John subsequently joined the Mufulira copper mine project in Zambia and two years later he took up the position of project manager of the water treatment plant project at Riffa, Bahrain.

In 1999 John was enrolled at the University of Pretoria where he studied towards his master degree, graduating in 2002 with a M. Eng degree, in Project Management.

A few months after graduating from UP, John joined the French Agency (L'Agence nationale pour la gestion des déchets radioactifs ) in Bure, France as a Principal Consultant, to provide project risk management towards shaft sinking operations.

John came back to South Africa in 2006 and joined RSV as a consulting engineer dedicated specifically to gold and platinum projects. In 2008 he joined CBS Australia (Pty) Ltd, where he presently works. Since 2015 John is studying towards PhD degree in mining engineering at Wits University.

John is married to Evelyn and has a daughter Isabella and two grandsons Juan and Tatum. John enjoys classical music, plays the accordion and harmonica. ◆

# SAIMM Branch Chairmen



## Namibian Branch

**Nikowa Mabvuto Namate**

Nikowa is the Deputy Head of Department and Lecturer, Mining and Process Engineering, Polytechnic of Namibia

His key attributes include:

- Mining Engineering Degree from University of Zimbabwe
- Over ten years of industrial and academic experience
- Strong team building capability and leadership skills
- Strong research interest in industrial engineering processes and ergonomics
- Certified energy auditor
- Small scale mining consultant

Nikowa has a good understanding of the mining industry in Namibia. ♦



## Northern Cape Branch

**Cedrick van Wyk**

Cedrick Van Wyk was born and grew up in Luderitz, Namibia. He completed schooling at the Concordia College in Windhoek, Namibia.

Cedrick joined JCI in 1989 as a learner official and completed the Higher National Diploma in Extractive Metallurgy from the University of Johannesburg (Wits Technikon) in 1993. He completed the Anglo American MDP with the University of Stellenbosch Business School in 2005.

Cedrick was employed with Rustenburg Base Metals Refiners (Anglo Platinum) for seven and a half years. Four of those years were spent at the Base Metals Refiners (BMR) and a further three years' production experience was obtained in the Magnetic Concentration Plant (MC Plant). Cedrick also obtained two and a half years' experience in gold metallurgy at the Randfontein Estates Gold Mine, while studying towards his diploma.

Cedrick started working at Kumba Iron Ore Ltd in 2007 as a senior process engineer. He was promoted to Manager: Quality Assurance and Stewardship in 2008, followed by appointment to the post of Process Development Manager, DMS Plant. He is currently Principal Metallurgist in the Technical Services Department at Kumba's Sishen Mine, a post he has held since October 2012.

Cedrick is a member of the South African Coal Processing Society and the South African Institute of Mining and Metallurgy. He is married to Mildred and the couple have three children: Griffith, Tracy-Leigh, and Robin. They currently live in Kathu in the Northern Cape. ♦

# SAIMM Branch Chairmen



**Pretoria Branch**  
**Pierre Bredell**

Pierre has been an active mining engineer since 1996. His early years were with Randfontein Estates Gold Mines and Centrocen Projects. In 2000, Pierre co-founded and developed LQS International, a geological and mining engineering consultancy with offices in Johannesburg, Perth, Vancouver, Santiago, and London. From 2005 to 2009, Pierre was responsible for developing the company's international business from a base in London, UK. His primary responsibilities during this period were corporate development, client relations, project management, and due diligence. He has considerable experience managing and coordinating people and working in the technical environments of open pit and underground mining. LQS International was bought by DRA International in 2010.

In 2012, Pierre joined the University of Pretoria, South Africa, as a senior lecturer in the Mining Engineering Department. Here he shares his expertise in mineral economics and risk management. ♦



**Western Cape Branch**  
**Craig Sweet**

Craig spent 8 years with Anglo Platinum, where he focused on PGM concentrator design, operational management, and plant optimization. He led the recapitalization of a number of older concentrators in the group and filled the role of Technical Manager of the Process Business Unit at the time of his resignation. He spent 5 years employed by MPTech, the University of Cape Town's mineral processing consultancy, where he focused on mineral processing plant optimization. In this capacity he was involved with optimization projects on, among others, Anglo Platinum's Waterval UG2, Waterval Merensky Retrofit plant, Potgietersrus Platinum, and Mototolo operations, and Xstrata's Eland Platinum Mine operation.

Craig was Project Manager - Process, for the very successful phases 1 and 2 of the Tharisa Chrome and PGM project, and Project Manager - Process for Kameni Ltd. He completed process design on greenfield and brownfield platinum and chrome projects, including smelter work. Other experience includes rare earth elements, gold processing in Mali, tin recovery in the DRC, and numerous comminution, classification, gravity separation, and flotation processes.

Craig played a leading role in the establishment of a technical development programme for metallurgical graduates at a major mining house.

He works in a multidisciplinary alliance known as The HeadRoom Initiative, where participants focus on solving interesting and challenging problems that extend across a number of engineering disciplines, without the overhead costs and structures of traditional engineering companies. ♦

# SAIMM Branch Chairmen



## Zambian Branch

**Darius Muma**

Darius was born on 26 September 1976 in the Luanshya district of the Copperbelt Province, Zambia. He gained a BSc (Chemistry at the University of Zambia (UNZA), Lusaka, in 2004, and a (BEd) in Environmental Education, also at UNZA, in 2016. He also holds a Diploma in Business Management from the Association of Business Executives (ABE), UK.

From 2004–2005 Darius worked as an Environmental Project Assistant at UNZA School of Mines with the Advocacy for Environmental Restoration Zambia (AREZ) in Lusaka. In October 2005 he joined Konkola Copper Mines as a graduate chemist, progressing to senior chemist, sectional chemist, and acting Head of Analytical Services at Nchanga Mine in Chingola. In March 2014 he joined Mopani Copper Mines, where he is currently Assistant Superintendent Technical in the Analytical Services Department, Mufulira mine site.

Darius has a wide range of specialized skills and training, including X-ray fluorescence, fire assay and related pyrometallurgical analysis techniques, laboratory auditing, chemometrics and intelligent laboratory systems, metallurgical accounting, and laboratory information management systems. He is a Member of the SAIMM (currently Chairperson of the Zambian Branch), the Royal Society of Chemistry (RSC), the Chemical Society of Zambia (CSZ) (currently Northern Region secretary), the Engineering Institution of Zambia (EIZ), and a student member of ABE, UK

Darius is married to Priscilla Chola, a professional nurse in the Zambian Ministry of Health. They have two children; Martin Kazandwe and Precious Mwaba Muma. ♦



## Zimbabwean Branch

**Stanley Matutu**

Stanley graduated at the University of Zimbabwe in 1995 with an Honours Degree in Metallurgical Engineering, and gained his Masters in Business Administration (MBA), in 2002, also at the University of Zimbabwe. He commenced graduate traineeship in metallurgy in 1995 at Bindura Nickel Corporation in Zimbabwe, then owned by Anglo American. He worked in the base metal concentrator, smelter, and refinery operations at Bindura and moved through the ranks from plant metallurgist to plant manager, then to the position of Group Projects Metallurgist in charge of metallurgical projects in the Bindura group.

In 2008 Stanley joined Zimbabwe Platinum Mines (Zimplats), a subsidiary of the Impala Platinum Group, where he is currently Metallurgical Services Manager in charge of metallurgy technical services and new metallurgical projects for the concentrator, smelter, and base metal refinery. ♦

# SAIMM Branch Chairmen



**Zululand Branch**  
**Christo Mienie**

Christo was born on 18 November 1963 in Vereeniging and matriculated in 1981. He obtained his Dip Tech (T5) in Metallurgical Engineering from the Vaal Triangle Technikon. He worked at Iscor (Mittal) Blast furnaces and their Research and Development department. His area of focus was iron manufacturing, with particular interest in the evaluation and characterization of iron ore, coal, and coke for the blast furnace, direct reduction, and Corex processes.

Christo joined Richards Bay Minerals (RBM) in 1992. He gained valuable metallurgical and production experience over the next 14 years at various RBM plants including the roaster, char plant, iron processing, slag processing, and the smelter. His metallurgical responsibilities included increasing the production of prime grade slag and pig iron, furnace rebuilds, working in conjunction with the marketing department to establish new markets and customers, and the introduction of best practices in the process metallurgical field.

His HR responsibilities included the management, training and development of metallurgists. He completed his MDP through the University of Durban Westville during 1997. Christo obtained valuable experience with regards to business restructuring ('right-sizing') while being the team leader responsible for the SHEQ and technical departments.

He resigned from the corporate world when he joined Spectrum Technical (Pty) Ltd in 2006 as a director and shareholder – his current position. Services to clients includes plant feasibility studies, flow sheet design, process equipment selection and supply, pilot-scale test work, plant commissioning, troubleshooting, and cost analyses in the metals and minerals industry.

Christo is married to Marietjie, and they have two boys – Francois and Christo Junior. He is a keen jogger. ♦



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advanced metals initiative



## Ferrous 2016 FERROUS AND BASE METALS DEVELOPMENT NETWORK CONFERENCE 2016

19–21 October 2016

Southern Sun Elangeni Maharani,  
KwaZulu-Natal, South Africa

### BACKGROUND

Through its Advanced Metals Initiative (AMI) the South African Department of Science and Technology (DST) promotes research, development and innovation across the entire value chain of the advanced metals field. The goal of this initiative is to achieve sustainable local mineral beneficiation and to increase the downstream value addition of advanced metals in a sustainable manner. The achievement of this is envisioned to be through human capital development on post-graduate and post-doctoral level, technology transfer, localization and ultimately, commercialisation.

The AMI comprises four networks, each focussing on a different group of metals. These are Light Metals, Precious Metals, Nuclear Materials and Ferrous and Base Metals (i.e. iron, steel, stainless steels, superalloys, copper, brass, etc.).

The AMI FMDN 2016 Conference aims to bring together stakeholders from the mineral sector, academia, steel industry, international research institutions and government in order to share and debate the latest trends, research and innovations, specifically in the areas of energy, petrochemical, corrosion, materials for extreme environments and transport, local mineral beneficiation and advanced manufacturing related to these materials.

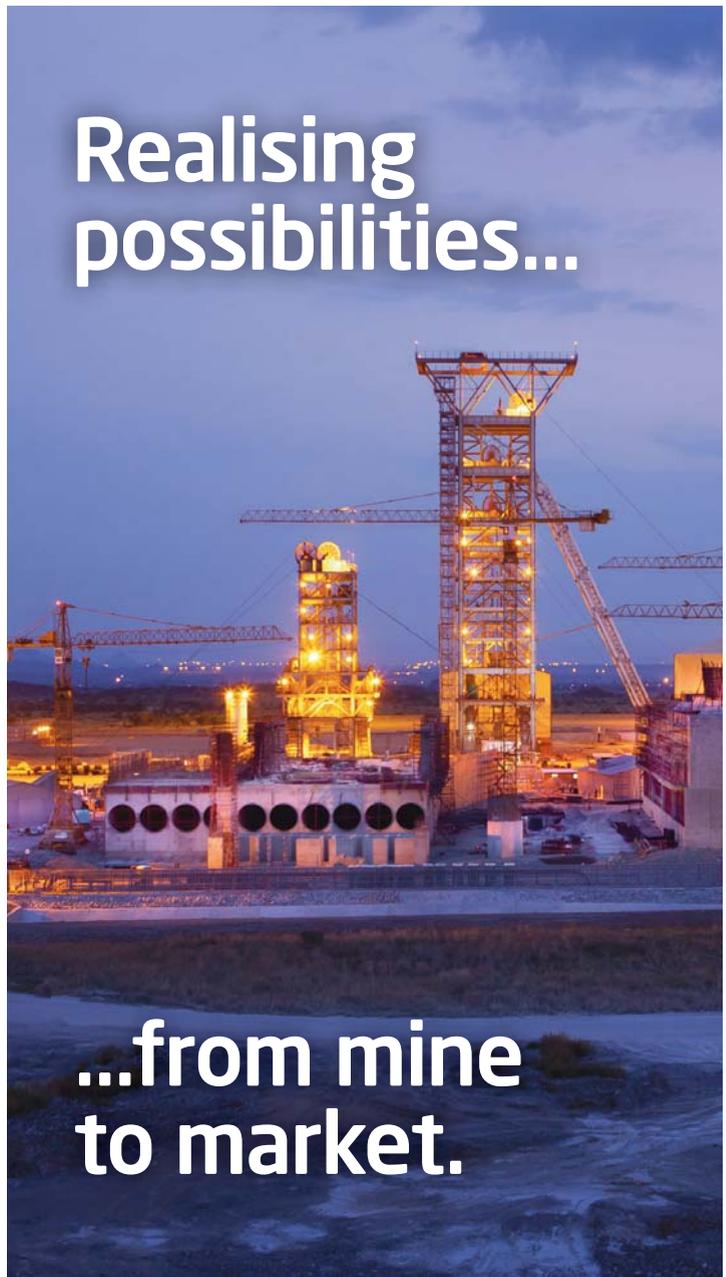
Keynote speakers to be invited include international specialists in the fields of ferrous metals, computational materials science, high temperature corrosion and mineral beneficiation.

The Ferrous and Base Metals Development Network (FMDN) of the DST's Advanced Metals Initiative (AMI) programme will host the AMI's annual conference in 2016. The conference seeks to share insight into the state of R&D under the AMI-FMDN programmes and explore and debate the following broad themes:

- ◀ Development of high performance ferrous and base metal alloys for application in the energy and petrochemical industries
- ◀ Development of corrosion resistant ferrous and base metal alloys
- ◀ Development of lightweight and/or durable steels for cost-effective transportation and infrastructure, and
- ◀ Panel discussions on possible future value-adding R&D programmes under FMDN within the South African National Imperatives.



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# Presidential Address: Optimization in underground mine planning—developments and opportunities

by C. Musingwini\*

## Synopsis

The application of mining-specific and generic optimization techniques in the mining industry is deeply rooted in the discipline of operations research (OR). OR has its origins in the British Royal Air Force and Army around the early 1930s. Its development continued during and after World War II. The application of OR techniques to optimization in the mining industry started to emerge in the early 1960s. Since then, optimization techniques have been applied to solve widely different mine planning problems. Mine planning plays an important role in the mine value chain as operations are measured against planned targets in order to evaluate operational performance. An optimized mine plan is expected to be sufficiently robust to ensure that actual outcomes are close or equal to planned targets, provided that variances due to poor performance are minimal. Despite the proliferation of optimization techniques in mine planning, optimization in underground mine planning is less extensively developed and applied than in open pit mine planning. This is due to the fact that optimization in underground mine planning is far more complex than open pit optimization. Optimization in underground mine planning has been executed in four broad areas, namely: development layouts, stope envelopes, production scheduling, and equipment selection and utilization. This paper highlights commonly applied optimization techniques, explores developments and opportunities, and makes a case for integrated three-dimensional (3D) stochastic optimization, in underground mine planning.

## Introduction

The late Mohandas Karamchand Gandhi, widely known as Mahatma Gandhi, lived from 1869 to 1948. He is regarded as the champion of the non-violent 1907–1914 Passive Resistance Campaign in South Africa and is also attributed with the words: *'Earth provides enough to satisfy every man's needs, but not every man's greed.'* These words were true back then, are true now, and will remain true into the foreseeable future as there will never be sufficient resources to satisfy human greed (or wants). This observation is a key premise in the study of economics, which recognises that humans have unlimited wants that must be satisfied from finite or scarce resources. Consequently, mankind must make choices on managing scarce resources for optimal allocation to satisfy human wants, but within limits of reasonable greed, otherwise continued survival on Earth may become impossible.

Optimal management of scarce resources is also central to the discipline of operations research (OR). OR has its origins in the United Kingdom around the early 1930s (*i.e.* pre-World War II era) when decision-making techniques were used by the British Royal Air Force and Army to find effective ways to kill as many enemy targets (*i.e.* people) as possible, using the least amount of resources (Beasley, n.d.). Accordingly, they recruited mathematicians, scientists, and engineers to solve different problems involving the allocation of scarce resources for military operations. The problems included operations such as bombing, anti-submarine strikes, the deployment of radar, and convoy management. Such work involved, for example, determining 'trade-offs' to evaluate what would be more effective: throwing one large bomb or throwing many small bombs at an enemy target, but in both cases using the same amount of bomb material, while increasing the probability of 'killing'. The application of mathematical, scientific, and engineering methods to military 'operations' led to this practice being called 'operations' research. Of course, such history inevitably bears some moral burden, but it is history.

In the post-World War II era, the ex-military OR workers moved into peacetime disciplines, thus triggering the spread of OR to universities and different industries. This marked the emergence of systematic training of OR professionals. Since most OR work involves carrying out a large number of numerical calculations, its proliferation has to a large extent been made possible by the widespread availability of computers and their greatly improved performance and data storage capacities.

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# Optimization in underground mine planning—developments and opportunities

In Europe OR is generally referred to as ‘operational research’, while in the USA it is generally referred to as ‘operations research’. Other terms that may be used synonymously with OR are: ‘management science’, ‘managerial decision-making tools’, ‘industrial engineering’, ‘value engineering’, ‘decision science’, ‘quantitative methods’, or ‘quantitative techniques’. OR techniques are scientific decision-making methods that are used to solve complex management problems in systems by applying modern science (and mathematics) in order to select the ‘best’ or ‘optimal’ decision among possible alternative solutions, under conditions requiring the allocation of scarce resources and in some cases, balancing competing objectives. A system is an organization of interdependent components that work together in alignment to accomplish desired objectives. A mining production process is a system with inputs and outputs, and can be represented schematically using a systems engineering framework (Figure 1) and so, is amenable to optimization using OR.

The primary objective of optimizing a system is to minimize inputs (since they are scarce or costly) while simultaneously maximizing desirable outputs (e.g. profits) and minimizing undesirable outputs (e.g. waste). The level of outputs is fed back in order to make necessary adjustments for improving the system’s performance. In a mining context, inputs (resources) are generally scarce and usually come at significant costs. For example, mineral resources and reserves are scarce and finite. So is time, since there are only 24 hours in a day.

Several techniques are available for solving different optimization problems, depending on how the problems are modelled. Modelling can be defined as the construction of a simplified representation of a system or its behaviour, using scientific and mathematical frameworks. Algorithms are used to test whether the model correctly represents the behaviour of the system in the real world, but without the model becoming a replica of the system. An algorithm is a step-by-step procedure that is executed iteratively to compare successive solutions until the process converges at an optimal solution. Due to the varied nature of problems encountered in the real world, different models have been developed to address the different types of problems that exist. The five main categories of OR models are:

1. *Optimization model*—a mathematical formulation that is solved using an exact algorithm to produce a single optimal solution through a process of either maximization or minimization
2. *Simulation model*—a model for comparing alternatives without necessarily guaranteeing an optimal solution,

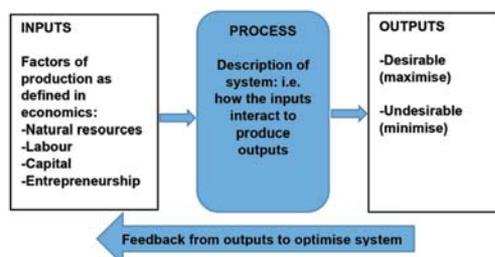


Figure 1—The mining production process as a system with a feedback loop

but is suitable for answering ‘what-if?’ type of questions or analysing risk in cases where decisions must deal with uncertainty

3. *Network model*—a model that is solved using a graphically-aided algorithm, also often producing a single optimal solution
4. *Multi-criteria decision-making (MCDM) model*—a model that is employed when decisions require several criteria to be considered simultaneously and generally the decision-making criteria are either competing, conflicting, or contradictory. ‘Trade-offs’ have to be made among the criteria in order to derive an optimal solution
5. *Global optimization model*—a model that uses a heuristic algorithm to find a solution to an intractable optimization problem, without necessarily guaranteeing an optimal solution. For example, the travelling salesman problem (TSP), in which a travelling salesman must visit several customers in different cities, each customer once, and use the shortest overall route, is typically solved using the nearest neighbour heuristic algorithm. Heuristic algorithms tend to be inspired by nature and are a major focus of this paper due to the complexity of optimization in underground mine planning.

OR methods have their own limitations because models are a simplification of reality. Therefore, problems should not be ‘forced to fit’ a model in order to solve them. Most optimization problems in mine planning do not perfectly fit exact algorithms, and are therefore best solved using heuristic approaches. The following sections briefly describe some of the optimization algorithms that have been used in the mining industry, but with more emphasis on heuristic algorithms such as the genetic algorithm (GA), particle swarm optimization (PSO), ant colony optimization (ACO), and simulated annealing (SA) algorithms as these have been used to solve optimization problems in mine planning that are mentioned in later sections.

## Optimization algorithms

### Simplex algorithm for solving linear programming (LP) problems

In 1947 George Bernard Dantzig introduced the simplex algorithm for solving linear programming (LP) problems. The general formulation of the LP problem is as follows:

$$\begin{aligned} &\text{Optimize } Z = c_i x_i \text{ for } i = 1, 2, \dots, n \\ &\text{s.t. } Ax = b \\ &\text{and } x_i \geq 0 \end{aligned}$$

where,  $Z$  is the objective function to be maximized or minimized with respect to variables  $x_i$ ,  $A$  is the matrix of  $c_i$  coefficients of  $x_i$ , and  $b$  is a vector of constraint limits.

Depending on the type of value that  $x_i$  is restricted to take, LP problems can be extended to their variants, which can be binary LP where  $x_i \in [0, 1]$ , mixed integer programming (MIP) where  $x_i$  can be integer or decimal, and integer programming (IP) where  $x_i \in \mathbb{Z}^+$ . The LP variants have been applied widely for optimization in mine planning, as chronicled by Osanloo *et al.* (2008) for open pit optimization and Newman *et al.* (2010) for optimization in underground mine planning.

# Optimization in underground mine planning—developments and opportunities

## Dynamic programming (DP) algorithm

In 1957 Richard Ernest Bellman developed a framework based on recursion to solve DP problems. A dynamic process or system is optimally laid out when the decisions taken beginning from a given stage,  $n$ , are such that the layout of the process from stage  $n$  to the end will be optimal regardless of the decisions taken to enter  $n$ . For example, in a four-stage process to maximize output where  $S_3 > S_2 > S_1$ , then state  $S_3$  in stage 4 is the optimal choice when moving from stage 3 to stage 4 (Figure 2).

DP problems are solved using forward pass and backward pass algorithms. In the forward pass a recursion formula is applied to each stage and the temporary optimum is saved in memory. At the end, a backward pass traces back the path leading to the optimal value. The general recursive formula used is  $f_n = \text{Opt} \{f_{n-1} + g_n\}$ , where  $\text{Opt}$  is either maximum or minimum,  $f_n$  is the function value at point  $n$ , which is a state in a given stage,  $f_{n-1}$  is the function value in a previous consecutive point  $n-1$ , and  $g_n$  is the value for moving from  $n-1$  to  $n$ . The DP algorithm has been used for open pit optimization (e.g. Lerchs and Grossmann, 1965) and optimization in underground mine planning (e.g. Dowd and Elvan, 1987) for grade control and scheduling.

## Genetic algorithm (GA)

In his 1975 book titled *Adaptation in Natural and Artificial Systems*, John Holland presented the genetic algorithm (GA) as a method to mimic the processes of biological evolution through natural selection or the principle of 'survival of the fittest' for solving global optimization problems. Consider a normal population of rabbits, some of which are faster and smarter than others. The faster and smarter rabbits are less likely to fall prey to predators such as foxes, but some of the slower and less smart survive out of sheer luck. The larger number of the faster and smarter rabbits that survive continue to do what rabbits do best: make more rabbits amongst themselves, but also with the slower and less smart that are lucky to survive. It is expected that the resulting baby rabbits will, on average, be faster and smarter. The GA is a step-by-step procedure that mimics the rabbit story (Table I). GAs have been used to solve production scheduling optimization problems in mine planning, such as in the work reported by Kumral (2004) for production blending from different mining locations in a central processing facility to maximize net present value (NPV) over time.

## Particle swarm optimization (PSO) algorithm

The particle swarm optimization (PSO) algorithm is a fairly

recent method applied to solve global optimization problems. It was first proposed in 1995 by Kennedy, a social psychologist and Eberhart, an electrical engineer, who conceptualized that social behaviour can be used to solve optimization problems in engineering. It mimics the social behaviour of populations of animals, fish, and flying creatures such as bees and birds. For example, suppose that a flock of birds is randomly flying looking for food in a finite area. Initially, none of the birds has any knowledge on the exact location of the food, but any bird must have the best strategy for finding the food quickly. By frequently changing flying direction suddenly (i.e. velocity change), scattering, and then regrouping, the birds engage in social exchange of information. Individual birds are able to profit from the discoveries and previous experiences of other birds during the search for food. Since the birds (i.e. particles) change their position or state with time, the particles in a population (i.e. swarm) move around in a three-dimensional (3D) space in search of more promising regions (lower functional values for shorter distances) within the finite space than previously visited regions. The particle adjusts its flying position (i.e. vector addition) according to its own experience and position (personal best position) and that of its neighbours (global best position).

The vector addition procedure can be visually explained using the space diagram in Figure 3. Suppose at time  $t-1$  a particle is at position  $O$ , with its personal best position as  $A$  and global best position as  $C$ . If the current velocity of the particle is  $B$ , it will have a resultant direction defined by vector  $OD$ .

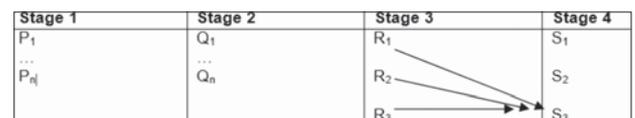


Figure 2—Illustration of an optimal DP selection for maximization

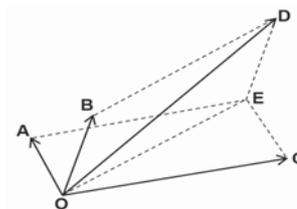


Figure 3—A space diagram of personal best and global best positions with resultant vector

Table I

### Overview of the steps in the GA

- Step 1:** Generate an initial population of parent individuals (feasible solutions),  $G$ , of size  $N$ . Each individual is represented by a chromosome (i.e. a string of characteristic genes).
- Step 2:** Generate offspring through:
- 2.1. *Selection*—selecting  $m \leq N$  strings as parents, so that the probability of each string being selected is proportional to its fitness. The fittest parents are ranked top through a fitness function and the fittest are selected for breeding.
  - 2.2. *Crossover*—the parents are paired and generate  $m$  offspring, which replace the  $m$  least fit strings or their parents. A crossover combines the features of two parent chromosomes to form two similar offspring by swapping corresponding segments of parent genes.
  - 2.3. *Mutation*—each string has a small probability  $\beta$  of being mutated.
- Step 3:** Repeat Step 2 until the function values of the points  $f(x_i)$ , for  $i = 1, 2, \dots, N$  are close to each other, that is to say, the standard deviation is very small.

## Optimization in underground mine planning—developments and opportunities

Khan and Niemann-Delius (2014) provided the following two vector equations for finding better positions in the search space to describe the PSO problem formulation:

$$\vec{x}_{i,t} = \vec{x}_{i,t-1} + \vec{\vartheta}_{i,t}$$

$$\vec{\vartheta}_{i,t} = \omega \vec{\vartheta}_{i,t-1} + c_1 \vec{r}_1 \cdot (\vec{p}_{i,t-1} - \vec{x}_{i,t-1}) + c_2 \vec{r}_2 \cdot (\vec{g}_{t-1} - \vec{x}_{i,t-1})$$

$\vec{x}_{i,t}$  and  $\vec{x}_{i,t-1}$  are the positions of the particle  $i$  during current and previous iterations, respectively  
 $\vec{\vartheta}_{i,t}$  and  $\vec{\vartheta}_{i,t-1}$  are the velocities of the particle  $i$  during current and previous iterations, respectively  
 $\vec{p}_{i,t-1}$  is the personal best position experienced by particle  $i$  during the previous iteration  
 $\vec{g}_{t-1}$  is the global best position experienced by particle  $i$  during the previous iteration  
 $\omega$  is the inertia weight used to control the contribution of the particle's previous velocity  
 $c_1$  and  $c_2$  are the acceleration coefficients used to control the influence of cognitive and social terms on the particle's current velocity  
 $\vec{r}_1$  and  $\vec{r}_2$  are vectors of uniform random numbers between 0 and 1.

The velocity and position of the individual particles are iteratively adjusted using vector addition (Figure 4), which illustrates a step-by-step procedure for the PSO algorithm.

PSO is powerful in that it combines local (personal best position) with global (global best position) search methods. 'Personal best' is analogous to short-term planning or scheduling requirements in mine planning, while 'global best' is analogous to long-term scheduling requirements. PSO provides opportunities for integrating the optimization of short-term and long-term mine planning in 3D space so that the two can be executed simultaneously, such as in the work by Khan and Niemann-Delius (2014) and Goodfellow and Dimitrakopoulos (2016).

### Ant colony optimization (ACO) algorithm

The ant colony optimization (ACO) algorithm was initially proposed by Marco Dorigo in 1992 to mimic the behaviour of ants in finding an optimal path in graph theory. Ants, by nature, initially wander randomly until they find food. Then they return to their colony, while releasing pheromone (a hormone that triggers a social response by members of the same species) on the food trail. When other ants find the food path by following the pheromone, they tend to stop travelling at random, by following the trail and strengthening the attractiveness of the path and popularizing it by releasing more pheromone along the path. The pheromone evaporates with the passage of time, reducing the attractiveness of the path. A short or optimal path, therefore, is travelled over more frequently, thus increasing the pheromone density compared to longer paths. Pheromone evaporation has the advantage of avoiding the convergence to a locally optimal solution. If there were no evaporation at all, the paths chosen by the first ants would tend to be excessively attractive compared with subsequent paths. In that case, the

exploration of the solution space would be constrained. When an ant finds a short path from the colony to a food source, other ants are more likely to follow that path, reinforcing positive feedback and eventually leading to all the ants following that path (Figure 5). The idea of the ant colony algorithm is to mimic this behaviour with 'simulated ants' walking around the graph representing the problem to be solved. The ACO algorithm has been used for optimization of mine production scheduling by Gilani and Sattarvand (2016).

### Simulated annealing (SA) algorithm

Metropolis *et al.* (1953) used Monte Carlo simulation to develop the simulated annealing (SA) algorithm for simulating a collection of particles in thermal equilibrium at a given temperature,  $T$ . Annealing is a heat treatment process that involves heating a metal to above its recrystallization temperature followed by gradual cooling in still air or quenching in water in order to produce a workable metal that is more ductile and less hard, as its lattice structure is altered

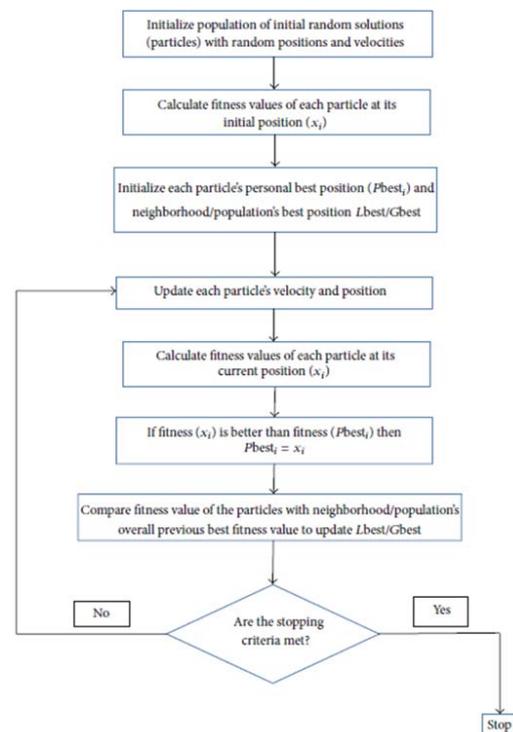


Figure 4—Flow diagram for the PSO algorithm (Khan and Niemann-Delius, 2014)



Figure 5—Ant colony behaviour that is mimicked by the ACO algorithm ([https://upload.wikimedia.org/wikipedia/commons/3/34/Safari\\_ants.jpg](https://upload.wikimedia.org/wikipedia/commons/3/34/Safari_ants.jpg))

## Optimization in underground mine planning—developments and opportunities

in the process. Rapid cooling usually results in local minima being formed (*i.e.* not the strongest lattice structure), while slow cooling, which takes more time, is likely to result in global minima being formed. Kirkpatrick *et al.* (1983) illustrated how the model for simulating the annealing of solids proposed by Metropolis *et al.* (1953) could be used to solve optimization problems. The Metropolis procedure starts by setting the surrounding temperature at  $T$  and then randomly selecting a state of the system of atoms or particles,  $s_i$ , which has a corresponding energy  $E_i$ . The system is then agitated and a new state,  $s_j$ , with energy  $E_j$  is established. If the change in energy  $\Delta E = E_j - E_i$  is negative (*i.e.*  $j$  is a lower energy state than  $i$ ), there is a reduction in energy, so  $s_j$  is accepted; otherwise the new higher energy state is accepted with probability  $\exp(-\Delta E / k_B T)$ . Table II gives an overview of the steps in the Metropolis algorithm.

Table III draws the analogy between simulating the annealing of a metal and solving a global optimization problem.

The Metropolis procedure has been extended for solving both discrete and continuous optimization problems. Dimitrakopoulos (2011) and Leite and Dimitrakopoulos (2014) used SA for production scheduling for an open pit mine and established that, when compared to conventional deterministic scheduling approaches, the SA schedules produced NPVs that were greater by about 25%.

### Role of mine planning in a mining system under uncertainty

The entire mining system is comprised of five main stages collectively known as the mine value chain (Figure 6). These

stages span from the initial discovery of a deposit from exploration activities to the final rehabilitation stage. Services such as planning, maintenance, human resources (HR), finance, engineering, and safety, health, environment, and community (SHEC) are required to support activities in each of the five main stages in the mine value chain.

Mine design and mine planning are two key supporting functions within the service area of planning. According to The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC Code), a mine design is 'a framework of mining components and processes taking into account such aspects as mining methods used, access to the orebody, personnel and material handling, ventilation, water, power, and other technical requirements, such that mine planning can be undertaken'. Mine planning is 'production planning and scheduling, within the mine design, taking into account such aspects as geological structures and mineralisation and associated infrastructure and other constraints' (SAMREC, 2016). The key distinguishing feature between the mine design process and mine planning is that mine design describes the detailed geometries and capacities of the engineering structures, while mine planning has the added dimension of time describing when and how each structure is constructed. Mine planning, therefore, plays an important role in the mine value chain as it is the basis upon which targets are set to monitor the performance of operations and ensure that mining systems are designed to operate optimally, with each stage in the mine value chain aligning with its upstream and downstream stages. Mine planning is executed from the development to the rehabilitation stages and is done throughout the life of a mining operation. At the development stage, mine planning involves Pre-feasibility Studies with 'trade-offs' similar to that done during OR development in the pre-World War II era, but in this case to evaluate options and the optimal one taken through to Feasibility Studies. After the Feasibility Study, construction of the mine then occurs, leading into exploitation.

Mine planning should produce an optimized plan. An optimized mine plan is expected to be sufficiently robust to ensure that actual outcomes are close or equal to planned targets, provided that variances arising from poor performance are minimal. However, due to the geological, technical, and economic uncertainties inherent in mining operations, this does not always happen in practice; hence the dichotomy that mine plans tend to be based on deterministic frameworks, while actual mining operations are stochastic in nature (Magagula *et al.*, 2015). This observation explains the emerging paradigm shift towards stochastic mine planning.

The failure to have actual outcomes close to or the same as planned targets is widely acknowledged in the mining industry due to the way the industry models its systems. For example, Gold Fields (2015) acknowledged that 'failure to achieve delivery against operational plans' was the second

Table II

#### Overview of the steps in the Metropolis algorithm

Set the surrounding temperature,  $T$   
 Select initial state  $s_i$  at random  
**Do**  
 Select new state  $s_j$  at random  
 Calculate  $\Delta E = E_j - E_i$   
 If  $\Delta E \leq 0$  then  $p = 1$ , else  $p = \exp(-\Delta E / k_B T)$ ;  
 If random  $[0,1] < p$  then  $s_i = s_j$ ;  
**Repeat until** thermal equilibrium is reached.

Table III

#### Analogy between physical annealing and global optimization

Physical annealing	Global optimization
Initial molten state at high temperature	Random selection of starting point ( $x$ )
Atomic position	Parameters or variables
Definition of the molecular structure	Definition of a vector
Internal energy $E$	Objective function $f$
Average energy $E$	Mean value of the objective function $f$
Ground state $E_0$ at low temperature	Global optimum (configuration)



Figure 6—A generic mine value chain

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top risk for their Australian operations. PriceWaterhouse Coopers (2015) proposed that mining companies should develop 'adaptable mine plans' to manage the impact of uncertainties such as commodity price volatility, thus implicitly advocating stochastic mine planning.

Mine plans can incorporate uncertainty such as price volatility if a shift is made away from deterministic to stochastic optimization. For example, by recognizing that commodity prices are volatile, Sabour and Poulin (2010) showed that instead of optimization models based on a commodity price,  $P$ , it is more reliable to use stochastic models for commodity price across time periods defined by  $\Delta t$ , where the price is expressed through the following stochastic differential equation (SDE):

$$dP = (r - \delta)Pdt + \sigma Pdz$$

where  $r$  is the risk-free rate of return,  $\delta$  is the mean convenience yield on holding one unit of that commodity,  $\sigma$  is the standard deviation or the volatility of  $P$ , and  $dz$  are the Wiener increments of the geometric Brownian motion of  $P$ . Haque *et al.* (2014) used the above SDE to derive the following partial differential equation (PDE):

$$\frac{1}{2}p^2\sigma^2\frac{\partial^2V}{\partial P^2} - q\frac{\partial V}{\partial Q} + (r - \delta)P\frac{\partial V}{\partial P} - (r + \lambda_c)V + q(P - C)(1 - G) = 0$$

where  $V$  is the value of the mining project;  $Q$  is the total mineral reserve;  $\lambda_c$  is the country risk premium;  $C$  is the total cost inclusive of capex and opex cost components; and  $G$  is the applicable tax rate. The derived PDE cannot be solved analytically. Therefore, heuristics are used to solve the PDE, thus indicating that solutions to stochastic optimisation in mine planning are computationally complex.

### Seminal work on optimization in mine planning and its extensions

The starting point for optimization in mine planning is a 3D block model that contains sufficient geological, geometallurgical, and geotechnical spatial data that informs a mine design and mine planning process. The 3D block model is the result of extensive geological and geostatistical investigations that delineate a mineral deposit's spatial characteristics into mining blocks (Sandanyake *et al.*, 2015) and, depending on the deposit size and granularity of available data, these blocks can be in the order of thousands, hundreds of thousands, or millions of blocks. Figure 7 schematically represents a 3D block model that is used as a key input to the mine design and mine planning processes, which include optimization as an integral component.

Optimization in the mining industry started to emerge around the early 1960s, despite OR techniques having been developed as early as the 1930s. Optimization in the mining industry can be attributed to the seminal work by Helmut Lerchs and Ingo F. Grossmann, who in the 1960s developed an algorithm to find the optimum design for an open pit mine. Their algorithm, which is known as the Lerchs-Grossmann (LG) algorithm, is an approach for solving the pit limit optimization problem, sometimes referred to as the 'ultimate pit limit' (UPL) or 'ultimate pit design' (UPD)

problem. On realizing that their algorithm could not be implemented on computers due to limited computing power at that time, Lerchs and Grossmann decided to publish their findings in the *Canadian Mining and Metallurgical Bulletin* of January 1965. They did this with the hope of revisiting implementation of the documented LG algorithm at a later stage when computing power had improved. True to their expectations, it was in 1986 that Jeff Whittle, who had become known to them, with his team successfully developed the first computer-based application of the LG algorithm, widely known in industry as the Whittle software package.

The basic assumption of the LG algorithm is that an open pit is mined essentially in two main directions, that is, downwards and sideways, but is limited sideways by geotechnically safe slope angles. The depth is limited by the economics of mining a block of ground on the  $i$ th row and  $j$ th column that is measured using a block economic value,  $B_{ij}$ . The block economic value is derived by subtracting the costs associated with mining and processing the block of ground from the revenue accruing from selling the recoverable mineral from that block. If  $B_{ij} < 0$ , it costs more to mine the block than the revenue obtained from it (*i.e.* the block should be treated as waste). If  $B_{ij} > 0$ , then mining of the block results in a net profit (*i.e.* the block should be treated as ore). If  $B_{ij} = 0$ , the block of ground is a mixed or marginal block. With these assumptions, an open pit can be viewed along section lines in 2D space. Figure 8 is a 2D illustration showing that block 1 can be mined only when blocks 2, 3, and 4 have been mined, irrespective of their  $B_{ij}$  values, assuming a 1:1 slope constraint.

The idea is to *maximize*  $Z = \sum B_{ij}$ , subject to a slope constraint, such as 1:1. It is possible to compute block column values,  $M_{ij}$ , by summing all  $B_{ij}$  values for blocks above and including the block, since a block cannot be mined until those above it have been mined. By applying dynamic

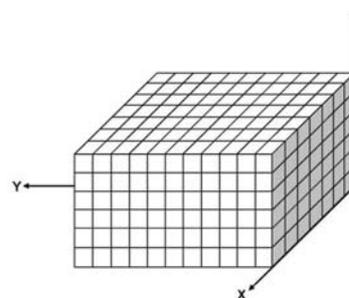


Figure 7—An isometric view of a 3D block model (Osanloo *et al.*, 2008)

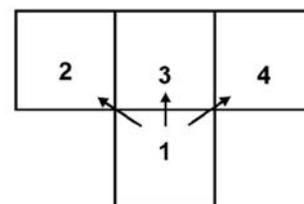


Figure 8—A 2D schematic illustration of open pit blocks

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programming it is possible to derive the maximum pit value by considering intermediate pit values,  $P_{ij}$ . The mathematical calculation framework is presented below.

$$M_{ij} = \sum_{n=1}^i m_{nj} \text{ for } j = 1, 2, \dots, j$$

where  $m_{nj}$  is the economic value of a block located in row  $n$  and column  $j$ ;  $j$  is the number of columns in the section;  $M_{ij}$  is the block column value; and the pit value,  $P_{ij}$ , is calculated as the maximum of the preceding pit values and the current block column value as follows:

$$P_{ij} = M_{ij} + \max \begin{cases} P_{i-1,j-1} \\ P_{i,j-1} \\ P_{i+1,j-1} \end{cases}$$

When the model is extended to cover real-world open pit optimization, the indexing of the model parameters changes from  $(i, j)$  to  $(i, j, k)$  for 3D space. Before a block (green block) can be mined in 3D, nine other blocks should have been mined previously (Figure 9). In moving from 2D to 3D the number of predecessor blocks increases from 3 to 9, hence the problem becomes computationally more difficult and requires more computational time. However, this challenge has been partly overcome through modified algorithms and the transition from 32-bit to 64-bit computers with about 24 GB RAM that are able to process computations quicker and have increased data storage capacity. With these computing developments a realistic open pit with about 5 million blocks each measuring 2 m × 2 m × 2 m can be processed in between 15 minutes and 3 hours, depending on the slope angles applied and how the LG algorithm was modified. However, 3D extensions of the LG algorithm tend to produce erratic results compared to the LG algorithm in 2D (Gholamnejad and Mojahedfar, 2010).

The inherent assumption in the LG algorithm is that block economic values are known with certainty. However, in the real mining environment, geological, technical, and economic parameters are never known with certainty, and also change over time due to improved understanding of an operation. To address uncertainty, optimization algorithms have been extended to their stochastic variants. For example, the work of Whittle *et al.* (2007) extended the deterministic pit optimization approach to generate probability pits with probabilities attached to each pit limit (Figure 10). In this way it is possible to proactively locate infrastructure outside limits that could eventually become part of the pit configuration should conditions change, thus improving the confidence level of the planning. A similar approach can be extended to optimization of stope envelopes in underground mine planning.

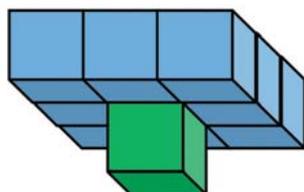


Figure 9—Example 3D schematic illustration of open pit blocks

## Circular logic of optimization in open pit and underground mine planning

Optimization in open pit mine planning follows a circular logic (Dagdelen, 2001; Osanloo *et al.*, 2008; Newman *et al.*, 2010). The objective is to maximize the NPV of the pit, but the pit outline with the maximum NPV cannot be determined until the block values are known. In turn, the block values are not known until the mining sequence is determined; and the mining sequence cannot be determined unless the pit outline and cut-off grade are known. The work by Lane (1988) is central to cut-off grade optimization, but as Alford *et al.* (2006) noted it has proved useful in the design of open pit mines, yet is difficult to apply to the design of underground mines. To simplify the problem so that it can be solved, the most common approach is to divide the problem into tractable sub-problems similar to that shown in Figure 11. However, by breaking down the problem into sub-problems, the resultant solution will be sub-optimal because ‘the sum of the parts does not equal the whole’. This realization is driving the paradigm shift from isolated optimization towards integrated optimization.

The analogy between open pit optimization and optimization in underground mine planning is proposed in Figure 12, which indicates the circular logic of optimization in underground mine planning. Again, the optimization problem in underground mine planning is divided into computationally tractable sub-problems as with the open pit optimization case.

The optimization objective is to maximize the NPV of the mine design, but the development and stope layout with the maximum NPV cannot be determined until the production costs and associated cut-off grade are known. In turn, the production costs and associated cut-off grade are not known until the mining layout and production scheduling have been determined; and the mining layout and scheduling cannot be determined unless the mining method and production capacity are available. Selection of the mining method is an MCDM optimization exercise such as in the work of

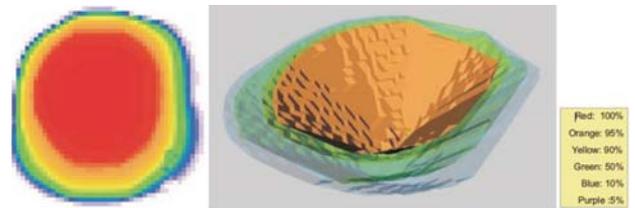


Figure 10—Example of a probability pit design (Whittle *et al.*, 2007)

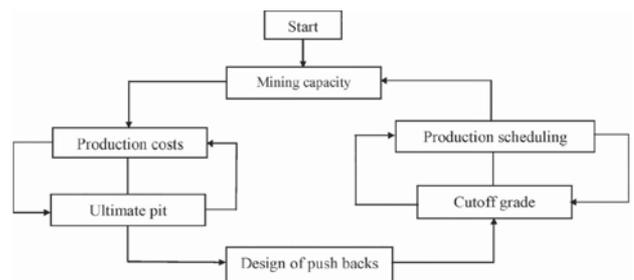


Figure 11—Circular logic of open pit optimization (Osanloo *et al.*, 2008)

## Optimization in underground mine planning—developments and opportunities

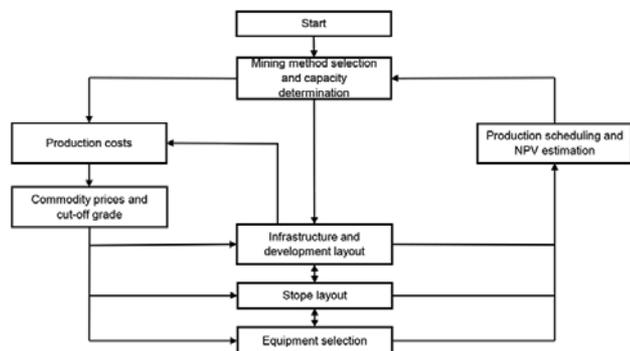


Figure 12—Analogy of the circular logic of underground optimization

Musingwini and Minnitt (2008) and Karadogan *et al.* (2008). Yavuz (2015) listed 15 case studies in which MCDM techniques have been used for mining method selection. However, mining method selection is dependent on prior determination of production capacity. Work on determining optimal sizing of the production of a mine was pioneered by Taylor (1986), and a historical review of work done on optimizing mine capacity was provided by Hajdasinski (1988).

King (2011) noted the complexity around the interpretation of the ‘optimal’ concept by mining engineers, especially when optimization is done in isolation as some form of technical or financial optimization. However, it is always important to understand the general optimization process in mine planning in order to meaningfully interpret the results obtained. Education and training in optimization in mine planning are essential to realize this objective.

### Developments in optimization in underground mine planning

As stated earlier, optimization in open pit mine planning is well developed and widely applied because for an open pit mine, the direction of mining is essentially down and outward to the pit limits. However, optimization in underground mine planning is intrinsically more complex, because there are numerous permutations of the direction of mining, such as advance or retreat mining, depending on the mining method chosen (Alford *et al.*, 2006; Musingwini 2009, 2010; Topal and Sens, 2010; Sandanayake, 2014). In addition, individual underground mines have unique designs and operations to suit the specific characteristics of each mineral deposit, thus making generic optimization difficult (Newman *et al.*, 2010; Alford *et al.*, 2006). It has also been observed that most of the optimization algorithms in underground mine planning fail to guarantee true optimality in a 3D space (Ataee-Pour, 2000; Sandanayake, 2014). These are the main reasons why there is a lack of extensive optimization algorithms and commercial software packages for underground mining, and why most of the work on optimization in underground mine planning is largely academic. There are a few practical applications, such as that of Alford (1995), which is embedded in Datamine, Snowden’s Stopesizer mining software package, used internally by Snowden Consultants to produce a single mining outline for a selected cut-off grade, and the Anglo Platinum Optimisation Tool (APMOT) (Smit and Lane, 2010).

Optimization in underground mine planning has therefore been focused on three main areas, namely: development infrastructure layout; stope boundaries or envelopes; and production scheduling (Sens and Topal, 2009; Topal and Sens, 2010; Sandanayake, 2014). Optimizing equipment selection and deployment is also part of underground mine planning. Selection and deployment of equipment is important because ignoring it can result in operational inefficiency, with operational symptoms such as low equipment productivity. With proper mine planning, equipment utilization can also be improved through optimization processes such as the Theory of Constraints (TOC). Most of the developments in optimization in mine planning have been made possible through the greatly improved computing power and capacity and increased exposure to OR techniques by the mining industry.

### Developments in optimization of development layout

Figure 13 is a schematic layout of a steeply dipping, narrow-reef underground mine, showing stopes that are demarcated by main development such as levels and raises. The challenge with underground mining is that unlike open pit mining, it is very unforgiving because once the development infrastructure has been laid out, the operation is ‘locked-in’ to the layout and any future layout changes can be very capital-intensive. Therefore, optimization of the development layout is critical for the future operation of an underground mine.

Optimization of the development layout must consider financial, technical, and safety requirements (Musingwini, 2009, 2010). The financial requirements include minimizing operating costs by spacing out development, minimizing capital costs, and maximizing NPV. The technical requirements include maximizing shaft head grade through selective mining, which is possible if development spacing is reduced; maximizing extraction ratio, and maximizing productivity by reducing development spacing. The safety requirements include concentrating production in areas close to each other to improve supervision and minimizing unsupported spans to achieve better geotechnical stability, which can be achieved by reducing development spacing. When spacing of development is increased, some of the associated desirable and undesirable impacts that occur concomitantly, resulting in conflicting objectives are (Musingwini, 2009, 2010):

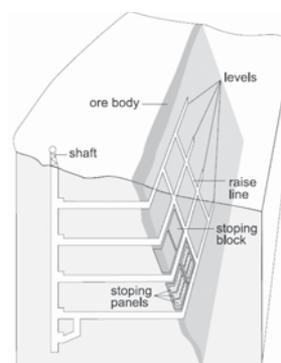


Figure 13—A 3D schematic illustration of a steeply dipping narrow-reef underground mine (Bley and Terblanche, n.d.)

## Optimization in underground mine planning—developments and opportunities

- The stope size increases, resulting in a decrease in the number of stopes per unit area of the orebody. When the number of stopes per unit area decreases, the number of points of attack for production decreases, making it more difficult to relocate production teams should a stope area become unsafe. This is an undesirable outcome
- Operating flexibility decreases as a result of reduced points of attack caused by fewer stopes per unit area. This is an undesirable outcome
- Ore reserve replacement ratio increases since more reserves are created with less development. This is a desirable outcome
- Productivity decreases due to reduced flexibility and points of attack. This is an undesirable outcome, even though the decrease in productivity may be offset by potential savings in development costs
- An increase in development spacing reduces the number of areas and hence the density of sampling of stopes. This is undesirable because a decrease in sampling density compromises the quality of ore reserve estimation, although multiple point statistics (MPS) can now be applied to improve grade estimation for sparsely distributed samples
- By increasing development spacing, production stopes become more spread out, making concentrated mining difficult to achieve, leading to reduced productivity. In addition, supervision becomes increasingly difficult because working places are further apart, impacting both productivity and safety. Musingwini (2009, 2010) noted that increasing development spacing potentially leads to undesirable productivity and safety outcomes.

These observations indicate that the layout of development infrastructure has conflicting requirements and so should be optimized using MCDM techniques. Several case studies have been reported on the application of MCDM techniques for optimal layout of development, such as the work by Musingwini (2009, 2010).

### Developments in optimal sizing of stope envelopes

In order to generate an optimal stope layout it is necessary to combine several contiguous mining blocks, each with an economic value  $B_{ij}$ , into a set of stopes, while satisfying the physical mining and geotechnical requirements in order to produce a layout with maximum value. However, the decision on whether or not a mining block is included in a stope requires that all possible combinations from thousands of mining blocks are evaluated for variable stope sizes and

pillars to obtain the maximum value stopes. This introduces computational complexity in the stope optimization problem. Exact algorithms for such a problem are intractable, and heuristic algorithms are therefore used. Figure 14 illustrates the computational complexity in a simple 2D hypothetical orebody model containing just 64 mining blocks. These would be stopes as seen along a longitudinal section taken along strike in Figure 13.

Figure 14(a) illustrates a stope layout for a  $3 \times 3$  stope size in which a candidate mining block,  $b$ , may become part of 1 out of 9 possible stope combinations such as stopes 1 and 2. Avoiding of stope overlaps, as these are not practical, requires that only 1 out of the 9 stopes be selected, and the selected stope must result in an optimal value. Figure 14(b) shows that as the stope size increases, the candidate mining block,  $b$ , becomes part of 1 out of 16 possible stope combinations, indicating that as stope size increases the number of stope combinations escalates exponentially, thus making the problem more complex to solve. The complexity of the underground stope optimization problem necessitates solution by heuristic approaches. Consequently, few algorithms have been developed for optimizing underground mining stope envelopes and none of these approaches can guarantee an optimum solution in 3D space (Little, 2012). One of the earliest attempts at solving this problem was the work by Alford (1995), who developed the heuristic floating stope algorithm to define the optimum stope envelopes, analogous to the floating cone algorithm used in open pit optimization. The floating stope algorithm assumes that, given a cut-off grade and a minimum mining width, economic stopes can be defined. A stope shape of the minimum stope dimension is floated around the block model to locate the position of the stope with the highest grade. The main limitation of this algorithm is that stopes overlap, making it difficult to define optimum stope layouts and requiring manual interventions (Little, 2012). The multiple pass floating stope process and the Vulcan stope optimizer are some of the extensions of the floating stope algorithm embedded in the Datamine and Maptek mining software packages, respectively.

Ataee-Pour (2006) presented an application of the maximum value neighbourhood (MVN) heuristic algorithm to determine optimal stope envelopes. He ran a multiple pass of the algorithm to remove waste blocks from the final stope envelope and add other ore blocks to it, since a single-pass MVN stope envelope may contain waste blocks or exclude ore blocks.

Topal and Sens (2010) developed an algorithm to find an optimum stope layout for a given resource model in 3D for

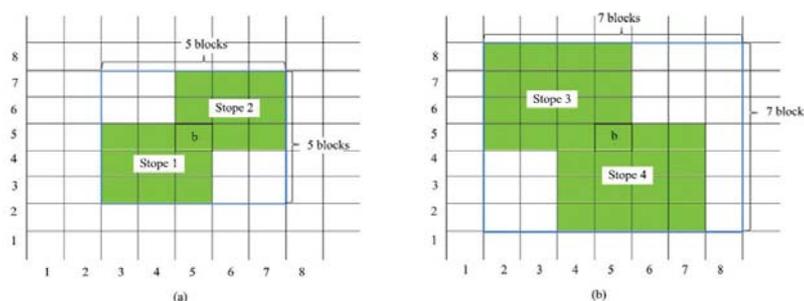


Figure 14—A 2D illustration of the optimal stope layout problem (Sandanayake et al., 2015)

## Optimization in underground mine planning—developments and opportunities

different stope sizes and stope selection strategies. Little (2012) developed an algorithm that simultaneously optimizes stope layouts and production schedules for sublevel stoping operations. The algorithm was developed using the integer programming (IP) technique. Previously, most underground optimization techniques focused on optimizing stope layouts and production schedules separately. The idea behind Little's algorithm was to integrate the two and optimize them simultaneously.

Sandanayake *et al.* (2015) developed a heuristic algorithm to find a 3D optimal stope layout for an orebody by maximizing economic value while satisfying mining and geotechnical constraints. When tested against the maximum value neighbourhood (MVN) algorithm and the Sens and Topal (2010) heuristic algorithm, the algorithm generated higher value solutions than these two existing algorithms.

### Developments in optimization of underground production scheduling

Production scheduling specifies the mining sequence for economic stopes and the associated mine development required to bring the stopes into production. The optimization decision hinges on variables that represent the time at which to mine each stope in order to maximize NPV subject to operational constraints such as mining infrastructure production capacity constraints, milling capacity constraints, grade and geometallurgical constraints, and rules on precedence relationships between stopes. Production scheduling can be executed for both short-term and long-term planning. Short-term and long-term production scheduling optimization for mines has received a lot of attention through the application of LP variants such as IP and MIP (Alford *et al.*, 2006; Newman *et al.*, 2010). Integrated LP and MIP modules, also called large-scale linear programming solutions (LSPS), have also been used for production scheduling. For example, Guest *et al.* (n.d.) reported on the application of integrated LP for short-term production scheduling and MIP for long-term production scheduling for underground block cave operations.

Smit and Lane (2010) presented an application of the Anglo Platinum Mine Optimisation Tool (APMOT), which is a form of an enterprise-wide optimization tool for optimizing the scheduling of a mine production system for conventional or mechanized underground platinum mining by taking into account all geological, mine design, and mining method parameters. Their work was based on experience-based rules to constrain the system, but did not mention the application of any specific OR techniques.

### Developments in optimization of underground equipment selection and utilization

Geotechnical constraints dictate the size of excavations and hence the dimensions of equipment that can fit into those excavations, while complying with legal requirements for safety. Once the maximum equipment dimensions are known, the equipment optimization problem becomes a two-stage problem as described by Krause and Musingwini (2007) and Newman *et al.* (2010). The first stage focuses on fleet size estimation and the second on equipment deployment using computerized dispatch systems such as Dispatch®. For the first stage, MCDM techniques have generally been used to

optimize the selection of underground mining equipment fleets. In order to estimate the production rates and productivity of the equipment fleets, simulation studies have been done using such software as variants of the General Purpose Simulation System (GPSS) and Arena. In some cases models based on LP variants have been used for optimal equipment deployment, backed up by simulation analyses. In order to optimize equipment utilization, TOC has often been used, for example in the study by Andrews and Pickering (2010), who reported about 32% improvement in machine cycle time for an underground mechanized platinum mining operation.

### Opportunities in optimization in underground mine planning

The proliferation of commercially available optimization algorithms and software has been made possible by the greatly improved computing power and data storage capacity that has become available over the past decades. There is sometimes a tendency to accept whatever solution the computer or software package generates as 'true' or 'correct'. McCarthy (2010) also observed that many commercially available optimizers are presented as 'black boxes' that produce solutions which clients cannot verify as they are not privy to the optimizer methodology. Therefore, it is always important to understand the optimization processes in mine planning in order to meaningfully interpret and communicate results for decision-making. These and other challenges mentioned earlier create the following opportunities for optimization in underground mine planning:

- Offering mine planning and optimization specializations in university master's degree programmes such as the MSc in Mine Planning and Optimisation that was introduced in 2014 by Wits Mining (Musingwini, 2014). In addition, Wits Mining also established a small Mine Planning Optimisation and Valuation (MPOV) group that is researching various optimization algorithms for underground mining. Such programmes will develop better-equipped professionals who can contribute to solving mine planning optimization problems in the mining industry
- Developing more robust mine planning through stochastic optimization by extending the work of Whittle *et al.* (2007) on probability pit design to probability underground excavation design of stopes and development in order to improve confidence in the placement and sizing of excavations
- Integrating stochastic optimization within the four broad areas in underground mine planning – development layout, sizing stope envelopes, production scheduling, and equipment selection and utilization – so that these can be executed simultaneously and enable planning of just-in-time development as described by Musingwini (2004, 2009) and Musingwini *et al.* (2003). In addition, the integrated optimization should guarantee true optimality in 3D space and incorporate uncertainty, thus making a case for integrated 3D stochastic optimization
- Crafting simple, effective, and meaningful ways of communicating stochastic information for decision-making, which often requires some kind of 'crisp' values rather than a range of values as depicted in

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Figure 15. A possible way is to use an acceptable confidence level,  $C_{\text{plan}}$ , to plan production targets (e.g.  $C_{80}$ ,  $C_{85}$ ,  $C_{90}$ , etc.).  $C_{\text{plan}}$  is selected such that the variance between historical data (where it exists) and the planned target is at a minimum. Where historical data is not available, data from a reasonably similar operation can be used.

In all these opportunities, it is important to always ask questions such as: How do we know we are getting it right? Is it through obtaining higher NPVs? Is it because the optimized plans are robust enough for operations to survive tough economic times?

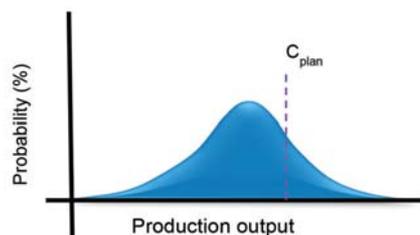


Figure 15—Translating stochastic output for deterministic mine planning

## Conclusions

Optimization in mine planning developed from the application of OR techniques to solve optimization problems in mining. Its growth has relied heavily on the greatly improved computing power and data storage capacity that has become available over the past decades. Consequently, well-developed optimization algorithms and software are now routinely applied to solve optimization problems in open pit mines. Open pit optimization developed extensively because the direction of mining in open pit mines is essentially down and outward to the pit limits, making the problem easy to model. However, optimization in underground mine planning remains largely fertile ground for new developments because the direction of mining in underground mines has numerous permutations, depending on the mining method used, making the underground mining optimization problem intrinsically more complex to solve. This complexity explains the isolated piecemeal developments for solving parts of the overall optimization problem in underground mine planning in four key interdependent areas, namely: development layout, sizing stope envelopes, production scheduling, and equipment selection and deployment. Many opportunities therefore, exist for the development of integrated 3D stochastic optimization models for underground mine planning.

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# Proceedings, 119th Annual General Meeting, 2016

The 119th Annual General Meeting of The Southern African Institute of Mining and Metallurgy was held at The Country Club, Johannesburg, Napier Road, Auckland Park on Thursday 11 August 2016.

## Welcome

The President, Rodney Jones, extended a special welcome to the guests and representatives of our sister institutes and other associations, and also to recipients of awards, senior members of industry, Honorary Life Fellows, past-Presidents, our members, and other guests, among them the following:

**Chamber of Mines of South Africa**, Mike Teke, *President*

**Geological Society of South Africa**, Jeanette McGill, *President*

**Geostatistical Association of South Africa**, Christina Dohm, *Chairperson*

**South African Colliery Managers' Association**, Lucky Mabuza, *President*

**South African National Institute for Rock Engineering**, William Joughin, *past-President*

**South African Institute of Electrical Engineers**, Thembinkosi Madikane, *President*

**South African Council for Natural Scientific Professions**, Gerda Botha, *President*

## Past-Presidents attending

Alf Brown	Joshua Ngoma
John Cruise	Rams Ramokgopa
Marek Dworzanowski	Mike Rogers
Frank Egerton	Don Ross-Watt
Henry James	Gordon Smith

## Minutes

The minutes of the previous Annual General Meeting, which were published in the September 2015 issue of the *Journal* and sent to all members, were confirmed.

## Obituaries

The President announced the deaths, during the year, of the following members:

### Honorary Life Fellows

Richard Peter Mohring, *SAIMM past-President, 1997–1998*

Robin Edmund Robinson, *SAIMM past-President, 1975–1976 and Journal Editorial Consultant, 1997–2000*

### Fellows

Andrew Simon Wood

### Retired Fellows

Robert Carruthers Bertram, Johan Theunis Fourie, David Lester Jackson Lawrence, Benjamin Higginson Leinster Leach, David Rankin

### Members

Gerrit Johannes Cornelius Strydom

### Retired Members

Thomas Edwin Green, Roy Staveley Traviss

### Associate

Prince Charingira

In memory of the deceased and in sympathy with the bereaved, all rose and observed a moment of silence.

## Honorary Life Fellowship

*Mzila Mthenjane*: Honorary Life Fellowship is awarded by the Council to Corporate members of the Institute who have rendered outstanding service to the Institute over many years. It is my pleasure to announce that the Council has decided to award Honorary Fellowship to:

- *Jim Porter*, for his outstanding leadership of the SAIMM over many years, *past-President of the SAIMM*.
- *Rams Ramokgopa*, for his outstanding leadership of the SAIMM over many years, *past-President of the SAIMM*.
- *Gordon Smith*, for his outstanding leadership of the SAIMM over many years, *past-President of the SAIMM*.
- *Richard Minnitt*, for his outstanding contribution to the SAIMM over many years.

## Brigadier Stokes Memorial Award

*Rodney Jones*: The Brigadier Stokes Memorial Award was instituted in 1980 to commemorate the outstanding contribution to the South African mining industry made by Brigadier R.S.G. Stokes, an Honorary Life Fellow and past-President of this Institute. This is the premier award of the Southern African Institute of Mining and Metallurgy and is made to an individual for the very highest achievement in the South African mining and metallurgical industry. It gives me great pleasure to announce that the award for 2016 is to be made to Mavis Hermanus.

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*Rodney Jones called upon Alastair Macfarlane, to read the citation:*

May Hermanus has made an exceptional contribution to the South African mining industry, covering a broad spectrum of arenas that continue to benefit the growth, development, and transformation of the country.

May, who was born in Cape Town, matriculated from the South Peninsula High School in the Western Cape. She then graduated with a BSc in geology from the University of Cape Town in 1981, and then went on to study for a Master of Science degree in Engineering and Physical Metallurgy at the University of the Witwatersrand, which she received in 1986.

It was during 1986 that she joined Boart International, where she worked as a Research Scientist, working on research into the bonding of diamonds into metal complexes, material failures, and the testing of the durability of these as cutting tools.

In 1988, she joined the National Union of Mineworkers as the Head of the Health and Safety Department. This was at a time of difficult relationships between the NUM and industry, but she laid the foundations for constructive engagement by establishing clear policies and direction for the NUM. Her work included organizing and formalizing the work and structures of the NUM to become a respected, effective and necessary protector of workers, rights in the field of health and safety. She also represented NUM at meetings of the Miners' International Federation, at the International Labour Organization, and the Advisory Committee to the Government Mining Engineer, and at health and safety conferences. Inputs made at the ILO and to the IMF (International Miners' Federation) contributed to the development of the Occupational Safety and Health in Mines Convention 1995. She was instrumental in leading the NUM campaign for a commission of inquiry into mine safety and health which led to the appointment of Judge R. Leon to lead such a commission. The Commission's report in turn led to the drafting and promulgation of the Mine Health and Safety Act of 1996.

She then became a Research Officer at the Centre for Applied Legal Studies at the University of the Witwatersrand, from March 1992 to December 1993.

In this work, she coordinated the preparation of the NUM technical submissions to the Commission of Inquiry into Mine Safety and Health, whose work culminated in fundamental changes in law and practice. She also assisted the NUM and its advisors in developing arguments for, and an approach to, the Inquiry. She also participated in the research programme concerned with social security, and continued to assist the NUM and the Congress of South African Trade Unions with representations on health and safety legislation.

In 1994, she was approached by Samancor to become their Group Health and Safety Manager, which she duly accepted.

In this appointment, which lasted for four years, she not only managed all of the routine functions of a group safety

department, but also used her experience to forge health and safety agreements through the encouragement of worker participation, and initiated risk assessment and risk management programmes as we know them today. She also initiated a number of research projects into health and safety matters and extended the portfolio into an integrated approach within the company into health, safety, and environmental issues.

The most significant health-related initiative involved a study of manganese exposure and its effects, undertaken by academics at UCT, and the most significant safety initiative was a study tour to assess furnace control practice with particular reference to water leaks.

She initiated the development of the corporate policy on AIDS/HIV and oversaw the initial actuarial research project to assess prevalence and draw attention to the attendant social issues.

While employed at Samancor, she gave evidence to the Commission of Inquiry into Safety and Health in the Mining Industry on behalf of the NUM and also served as an assessor for the inquest-inquiry, and commissioner for the Commission of Inquiry into the disaster at Vaal Reefs Mine which claimed the lives of 104 mineworkers in May 1995.

In 1998, she became a Takemi Fellow, at the Harvard School of Public Health in Boston, MA, USA.

At Harvard she engaged in research dealing with trends in occupational health and safety policy and regulation. In particular, she explored worker health and safety in South Africa and the relationship between occupational health and safety policy, and environmental policy, and published a paper on the health effects of manganese. The policy research conducted at Harvard was later published as a monograph by the Labour Law Unit at the University of Cape Town.

She then spent a brief period as an independent consultant from 1999 to 2000, working with BHP Billiton, Eskom, and the Ghanaian Government. The work in Ghana concerned the development of national policy for occupational health and safety law, and national institutions.

In 2000, she then joined the Department of Minerals and Energy as Chief Inspector of Mines and Deputy Director-General: Mine Health and Safety.

As the Chief Inspector, she led and managed the Mine Inspectorate, and chaired the Mine Health and Safety Council and the Mining Qualifications Authority. At the same time, she served as the deputy chairperson of the mining sector's Tripartite Committee on HIV-AIDS, and as a member of the Minister of Labour's Advisory Committee for Occupational Health and Safety.

May's work as Chief Inspector included strategic leadership, managerial, and technical work. Strategic leadership included maintaining a network of relationships at local and international levels pertinent to the work of the Mine Inspectorate. She was instrumental in this period in the establishment of the Health and Safety Milestones, which we still strive to reach.

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While most visible work of the Mine Inspectorate involves investigations into mine accident, and disasters, other responsibilities included monitoring health and safety trends, advising on interventions to address health and safety, taking preventative action, considering appeals, and promoting health and safety. In the public sphere her work extended to issues of sustainable development, the environment, mine water management, disaster management, and decisions over the location of infrastructure and residential or industrial developments.

As Chair of the MQA, she addressed challenges specific to the sector which were addressed by the MQA including skills development for retrenched gold miners, expansion in platinum mining, and for transformation - job reservation and the inclusion of women in the sector.

During this six-year period, May transformed the Mines Inspectorate into a regulatory entity that commanded the respect of the industry, through her proactive and processes of engagement with industry and organized labour, as well as other stakeholders. Such an approach is one which we need now more than ever, if we are to further improve the health and safety record of our industry. It is very relevant to indicate that from the years 1993 to 2015, fatalities in the mining industry decreased from 615 in 1993 to 63 in 2015. There is little doubt that May's contribution to this decline is highly significant.

Another change in direction occurred in 2006, when she became Director and Adjunct-Professor at the Centre for Sustainability in Mining and Industry (CSMI) at the University of the Witwatersrand, a position which she held until 2013.

She was appointed to develop the Centre into a major provider of academic and continuing education in the fields of occupational, safety, health, environment, and sustainable development (SHE&SD). In this work she developed many postgraduate-level courses and programmes, which have been most valuable to industry in dealing with sustainability issues. As the CSMI director she was also responsible for developing and maintaining a network of partnerships and stakeholders, which included the ICMM, major mining houses, organizations and companies involved in strategy / policy for the mining sector.

May is currently the Executive Director of Natural Resources and the Environment Unit at the CSIR. This unit focuses on research programmes that address climate change, integrated water management, waste management, biodiversity, and the green economy. Acid mine drainage and post-mining landscapes and economies are also among the NRE's areas of interest. May's responsibilities at the CSIR are mainly strategic and managerial. She also continues to work on mine health and safety and sustainability-related issues in the sector, in support of the activities of the CSMI at the University of the Witwatersrand. She has a visiting appointment as an Adjunct-Professor at the School of Mining Engineering.

May serves and has served on many industry boards, both locally and internationally. Currently, she serves as:

- Member of the Board of the Council for GeoSciences since 2012
- Member of the Board of Aveng Limited since 2009
- Chairperson of Anglo Gold Ashanti's Bokamoso Trust (an employee share ownership plan) since 2007
- Member of the Advisory Board of the Society, Work and Development Institute (formally the Sociology of Work Programme) at the University of the Witwatersrand since 2008.

She has also served as:

- Independent member of the Board of the Railway Safety Regulator from 2004 to 2013
- Member and Deputy Chairperson of the Board of Sacred Heart College, 2010-2013
- Member of the Board of the Railway Safety Regulator, from 2004 to 2013.
- Member of the Board of Afripalm Resources from September 2006 to September 2009
- Chairperson of the Board of the National Nuclear Regulator from December 2006 to November 2009
- Chairperson of the Mine Health and Safety Council
- Chairperson of the Board of the Mines Qualification Authority
- Member of the Advisory Council for Occupational Health and Safety to the Minister of Labour
- Board member of MEPC (Minerals and Energy Policy Centre)
- Board Member (1993-1998), National Labour and Economic Development Institute (NALEDI)
- Member of the Mintek Board.

Other appointments include:

- Chairperson of the ILO Tripartite Expert Committee Meeting convened in Geneva to revise the Code of Practice for Underground Coal Mining, May 2006
- Member of the Advisory Board of Miningtek
- Member of the Health and Safety Advisory Committee of the Ingwe Coal Corporation
- Commissioner, Commission of Inquiry into the Vaal Reefs Mine Disaster, 1996
- Health and Safety Advisor, Metal and Engineering Industries Education and Training Board (MEIETB), Education and Training Standards Project in 1995/6
- Fellow of the Sociology of Work Programme, University of the Witwatersrand
- Member of the National Manpower Commission's Occupational Health and Safety Technical Sub-Committee (1992 to 1993)
- Member (1992 to 1993) of the Human Rights and Law Reform Working Group of NACOSA (National AIDS Coordinating Committee of South Africa)
- Member of the Miner's International Federation's (MIF's) drafting committee for the Miner's Health and Safety Charter. Haltern, Germany.

May has published many papers, monographs, book chapters, and technical papers at conferences around the world, on issues related to sustainability, and health and safety in the mining industry.



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May is married to Antony Grant A'Bear, and they have two children Douglas Allen and Frances Kathryn. May reads widely, both fiction and non-fiction. Other favourite leisure activities include listening to music (jazz and blues), walking, being in the outdoors, admiring art and crafts, and spending time with family and friends.

I met with May recently, at which meeting she said she was rather concerned that she was not more active within the SAIMM. Given the fullness of her activities as I have described them, I doubt there would be enough hours in any day to do more than she already does for our industry.

Returning to my introduction, I am sure you all agree that May's experience and contributions to industry, from the point of view of many stakeholder's views, has enriched our industry. She explained to me that these experiences enriched her own understanding of the industry, and the contributions she has been able to make. And of course, that she continues to make, being still very active and at the pinnacle of her career. Our collaborative future requires that we engage constructively, and this can only be done where we understand and know each other, with mutual respect. May has been a fine role model that we can all follow in this regard.

Not only should we appreciate her efforts in their sheer magnitude, but we should also recognize that these have been done through the period of transition of our country from apartheid to democracy, at a time when she was a HDSA, coming from a marginalized community, and a female.

I think you will all agree that May is a most deserving candidate to join the illustrious set of names who have received this honour since 1980, and I would ask you to please join me in congratulating her, while at the same time paying our gratitude for all the contributions she has made, and continues to make.

*Alastair Macfarlane* called upon May Hermanus to come forward to collect her award from *Rodney Jones*. She then gave a short acceptance speech.

### Presentation of awards, medals, and certificates

*Mzila Mthenjane*: announced the following awards, medals, and certificates, which were presented by *Rodney Jones*.

### 50-year Membership Awards

(with effect from 1 July 1965 to 30 June 1966)

- Philippe Andersson
- John Anthony Cruise
- Frederick Simon Albert de Frey
- Frank Michael Gowar Egerton
- Frank Fenwick
- Michael Ryder Fuller-Good
- Peter Gordon Gaylard
- Johannes Paulus Hoffman
- Jou Loo
- William Mitchell
- David Ian Ossin

- Michael Howard Rogers
- Eric Hugh John
- Roy Stavely Traviss
- John Willoughby Walls
- Ian Clyde Watson
- Johan Christiaan Marais Wethmar.

### The Danie Krige Memorial Award

The Danie Krige Memorial Award was instituted in 2013 to honour the memory of Professor Danie Krige, who was one of South Africa's most influential mining engineers and a geostatistician of international repute.

The Danie Krige Memorial Award is considered for the best geostatistical paper published in the SAIMM *Journal* between January and December 2015.

This year's award was made to:

A. Cornah and E Machaka for their paper published in the June 2015 issue of the *Journal* entitled 'Integration of imprecise and biased data into mineral resource estimates'.

### Gold and Silver Medals

Papers published in the *Journal* from March 2015 to February 2016 by members of the Institute were considered for medals.

#### Gold Medals

Gold medals are awarded for papers that are of a world-class standard, and judged to be publications that will become key references in their mining or metallurgy field in the future.

Gold Medals were awarded to:

L.F. Contreras, for his paper published in the July 2015 issue of the *Journal* entitled 'An economic risk evaluation approach for pit slope optimization'.

D.K.Chibwe, G. Akdogan, G.A. Bezuidenhout, J.P.T. Kapusta, S. Bradshaw, and J.J. Eksteen, for their combined papers published in the May 2015 issue of the *Journal* entitled 'Sonic injection into a PGM Peirce-Smith converter: CFD modelling and industrial trials'.

and

'Modelling of fluid flow phenomena in Peirce-Smith copper converters and analysis of combined blowing concept' by D.K. Chibwe, G. Akdogan, P. Taskinen, and J.J. Eksteen.

D.K.Chibwe, G.A. Bezuidenhout, J.P.T. Kapusta, P. Taskinen, co-authors and non-members of the Institute, received certificates.

#### Silver Medals

Silver medals are awarded for papers that make a major contribution to the professions of mining and metallurgy and to the prestige of the Institute.

Silver Medals were awarded to:

J. Hager, V.S.S. Yadavalli, and R.C.W. Webber-Youngman for their paper published in the June 2015 issue of the *Journal* entitled 'Stochastic simulation for budget prediction for large surface mines in the South African mining industry'.

## Proceedings, 119th Annual General Meeting, 2016

R.H. Matjie, Z. Li, C.R. Ward, J.R. Bunt, and C.A. Strydom for their paper published in the February 2016 issue of the *Journal* entitled: 'Determination of mineral matter and elemental composition of individual macerals in coals from Highveld mines'.

Q.G. Reynolds, for his paper published in the May 2015 issue of the *Journal* entitled: 'Interaction of dust with the DC plasma arc – a computational modelling investigation'.

J.D. Steenkamp, P.C. Pistorius, and M. Tangstad, for their combined papers published in the March 2015 issue of the *Journal* entitled: 'Chemical wear analysis of a tap-hole on a SiMn production furnace'.

and

'Insights into the potential for reduced refractory wear in silicomanganese smelters' by J.D. Steenkamp, P.C. Pistorius, and J. Muller, published in the January 2016 issue of the *Journal*.

V.S.S. Yadavalli, R.H. Matjie, Z. Li, C.R. Ward, C.A. Strydom, M. Tangstad, co-authors and non-members of the Institute, received certificates.

### Presentation of Student Prizes

*Mzila Mthenjane* announced the student winners of the SAIMM Prestige Prize and *Rodney Jones* presented the awards to the students adjudged by their departments to be the best final-year students in 2015.

#### University of the Witwatersrand

Mining	Given Gift Sithole
Metallurgy	Fasebutse Jeff Malatji

#### University of Pretoria

Mining	Gerco Lindeque
Metallurgy	Nadia Snyman

#### University of Johannesburg

Mining	Avhaluvhei Ramovha
Metallurgy	Pierrick Twite

The following SAIMM student prizes were presented at the Western Cape Branch AGM on 17 August 2016.

#### University of Cape Town

Best final-year student	
Mineral Processing	Jenny Louise Roberston

#### University of Stellenbosch

Best final-year student	
Mineral Processing	Cara Broeksma

#### Cape Peninsula University of Technology

Best final-year student	
Chemical Engineering	Katende Jonathan Kabamba

The Western Cape Branch also awards two Outotec postgraduate scholarships for students conducting research in the area of sustainable mineral processing, but there was no award this year.

### SAIMM 5 Star Incentive Programme

The SAIMM 5 Star Incentive Programme was introduced in 2015 to thank members who contribute to the growing membership of the SAIMM and to provide additional benefits to Fellows and Members of the SAIMM. The following will receive free attendance at the Annual Banquet.

#### The Top 5 proposers were:

J. Steenkamp  
D. Muma  
M. Tlala  
N. Schoeman  
W. Kutekwatekwa.

#### The Top 5 referees of papers published in the Journal were:

M. Handley  
T. Stacey  
M. Dworzanowski  
S. Rupprecht  
G. Lane.

The authors who submitted and published the most number of papers in the *Journal* were:

J. Bunt  
J. Claassen  
R. Webber-Youngman.

#### Top advertiser in the Journal

The award for the *most supportive advertiser* in the *Journal* was made to Elbroc. Jan van Jaarsveld received the award on their behalf.

### Annual Report

*Rodney Jones* presented the Annual Report with highlights of his year as President.

### Accounts

The Honorary Treasurer, *Cuthbert Musingwini*, presented the financial statements, which are reproduced in the Annual Report in this edition of the *Journal*.

### Office bearers and Members of Council for 2016/2017

*Rodney Jones* announced the office bearers for the ensuing year, elected by the retiring Council in accordance with Clauses 3.5, 5.1, and 5.2 of the Constitution:

President	Cuthbert Musingwini
President-elect	Selo Ndlovu
Senior vice-President	Alastair Macfarlane
Junior vice-President	Mzila Mthenjane
Immediate past-President	Rodney Jones
Honorary Treasurer	Jim Porter
Co-opted Member	Zelmia Botha

In terms of the election of ordinary members of Council (Clause 3.2.7 of the Constitution and By-law B2.1), there were fourteen vacancies and the following members are now declared elected (in alphabetical order):

## Proceedings, 119th Annual General Meeting, 2016

Zelmia Botha	Godknows Njowa
Vaughn Duke	Andrew Smith
Isabel Geldenhuys	Michael Solomon
Matthew Handley	Mpho Tlala
William Joughin	David Tudor
Molefi Motuku	Dirk van Niekerk
Donovan Munro	Andrew van Zyl

In terms of By-law F1.7 of the Constitution, the chairpersons of the branches are as follows:

Botswana	Len Dimbunu
DRC	Susa Maleba
Johannesburg	John Luckmann
Namibia	Nikowa Namate
Northern Cape	Cedrick van Wyk
Pretoria	Pierre Bredell
Western Cape	Craig Sweet
Zambia	Darius Muma
Zimbabwe	Stanley Matutu
Zululand	Christo Mienie

These chairpersons will be *ex-officio* members of Council.

During the last year, your Council approved the establishment of a Young Professionals Council (YPC) to serve the needs of our members who are 35 years and younger to make the SAIMM more relevant and to ensure that we are in touch with the changing needs of our younger members.

In terms of By-law I, Clause 4.4.6 the YPC must consist of a minimum of 13 and a maximum of 18 members who are 35 years of age and younger. We received the required number of nominations and did not have to conduct a formal voting process.

The office bearers of the YPC are:

Chairman	Tshepo Mmola
Vice Chairman	Sihsenkosi Nhleko
Treasurer	Vulani Maseko
Secretary	Wesley Banda

The Chairman and Vice Chairman will represent the YPC on the SAIMM Council.

The following past-Presidents have signified their willingness to serve on Council for the ensuing year:

Nic Barcza	Rams Ramokgopa
Richard Beck	Mike Rogers
Roger Dixon	Don Ross-Watt
Marek Dworzanowski	Gordon Smith
Henry James	Willem van Niekerk
Gys Landman	Pat Willis
Joshua Ngoma	

*Rodney Jones* thanked those past-Presidents who indicated that they cannot serve on Council for the next year for all their time, effort, and dedication in the past.

He also thanked past-Presidents for their continued support. He congratulated all those elected, and thanked those who agreed to serve another term of office.

### Election of auditors and honorary legal advisers for 2016/2017

*Rodney Jones* proposed, and it was agreed, that R.H. Kitching be appointed as Auditor for the coming year and that Scop Incorporated be appointed as Honorary Legal Advisers.

### Induction of President

*Rodney Jones* introduced the new President, Cuthbert Musingwini, and then called upon *Mzila Mthenjane* to read his *curriculum vitae*.

### Presidential Address

Cuthbert Musingwini then presented his Presidential Address entitled: *Optimization in underground mine planning – developments and opportunities*, which is reproduced elsewhere in this edition of the *Journal*.

### Vote of thanks

*Selo Ndlovu*, gave the vote of thanks.

### Closure

The meeting closed at 19:00. ◆



Mzila Mthenjane announcing the award winners



Alastair Macfarlane reading the citation of May Hermanus



Selo Ndlovu delivering the vote of thanks

# Proceedings, 119th Annual General Meeting, 2016

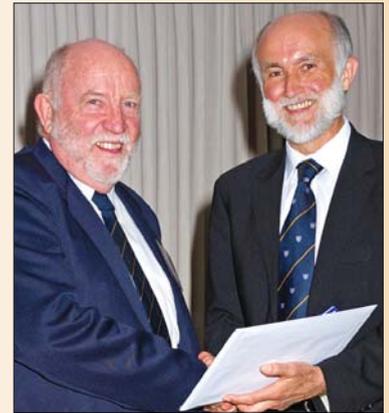
## Honorary Life Fellowship Awards



Rams Ramokgopa, receiving his Honorary Life Fellowship award from Rodney Jones



Gordon Smith, receiving his Honorary Life Fellowship award from Rodney Jones



Richard Minnitt, receiving his Honorary Life Fellowship award from Rodney Jones

## Brigadier Stokes Award



Mavis (May) Hermanus, recipient of the Brigadier Stokes Award, receiving her Platinum Medal

## Danie Krige Memorial Award



Alastair Cornah and Elelwani Machaka receiving their Danie Krige Memorial Award

## 50-year Membership Award (these awards were presented to the members at their respective homes)



Frank Fenwick, receiving his 50-year Membership lapel badge



Eric Stoyell, receiving his 50-year Membership lapel badge



Ian Watson, receiving his 50-year Membership lapel badge

# Proceedings, 119th Annual General Meeting, 2016

## 50-year Membership Award



Frederick de Frey, receiving his 50-year Membership lapel badge



Frank Egerton, receiving his 50-year Membership lapel badge



Michael Fuller-Good, receiving his 50-year Membership lapel badge



Peter Gaylard, receiving his 50-year Membership lapel badge



Jou Loo, receiving his 50-year Membership lapel badge



Michael Rogers, receiving his 50-year Membership lapel badge



Jen Traviss receiving the 50-year Membership lapel badge on behalf of her late husband Roy Traviss



## Gold Medal Award winners



Steven Bradshaw, Guven Akdogan, and Jacques Eksteen receiving the Gold Medal Award, for their combined paper that was published in the *Journal*

## Proceedings, 119th Annual General Meeting, 2016

### Silver Medal Award winners



Johann Hager and Ronnie Webber-Youngman, receiving their Silver Medal Award, for their combined paper that was published in the *Journal*



Henry Matjie, accepting the Silver Medal Award, on behalf of John Bunt, for their combined paper that was published in the *Journal*



Quinn Reynolds, accepting the Silver Medal Award for his paper that was published in the *Journal*



Joalet Steenkamp, accepting the Silver Medal Award for their combined paper that was published in the *Journal*

### Most Supportive Advertiser in the SAIMM Journal



Jan van Jaarsveld receiving the award on behalf of Elbroc as the Most Supportive Advertiser in the *Journal*



Jan van Jaarsveld and Grant Roach (CEO & Director) of Elbroc

# Proceedings, 119th Annual General Meeting, 2016

## Student Prizes



Given Sithole receiving his student prize



Gerco Lindeque receiving his student prize



Avhaluvhei Ramovha receiving his student prize



Pierrick Twite receiving his student prize



## Office Bearers for 2016/2017



Office Bearers for 2016/2017 – (from left to right): Sam Moola (Manager), Mzila Mthenjane, Rodney Jones, Cuthbert Musingwini, Selo Ndlovu, and Alastair Macfarlane

## Council members and Past Presidents of the SAIMM



Front row (from left to right): Alfred Brown, Rodney Jones, Cuthbert Musingwini, Rams Ramokgopa, Frank Egerton, Joshua Ngoma, Selo Ndlovu,  
Middle row (from left to right): Sam Moolla (Manager), Godknows Njowa, Pierre Bredell, Mzila Mthenjane, Henry James, Stanley Matutu, Nikowa Namate,  
Matthew Handley, Isabel Geldenhuys, Alastair Macfarlane, Mike Solomon, Marek Dworzanowski, Gordon Smith, Craig Sweet, John Luckmann,  
Back row (from left to right): Dirk van Niekerk, Don Ross-Watt, Susa Maleba, Darius Muma, Michael Rogers, John Cruise, William Joughin, Andrew Smith,  
Donovan Munro, Mpho Tlala

## Past Presidents of the SAIMM



Past Presidents serving on Council—Front row (from left to right): Joshua Ngoma (2009–2010), Henry James (1985–1986), Rodney Jones (2015–2016),  
Alfred Brown (1982–1983), Rams Ramokgopa (2002–2003), Frank Egerton (2004–2005), Gordon Smith (2012–2013)  
Back row (from left to right): Michael Rogers (1999–2000), Don Ross-Watt (1995–1996), John Cruise (1994–1995), Marek Dworzanowski (2013–2014)

## Proceedings, 119th Annual General Meeting, 2016

### Members and their guests at the cocktail party



Frederick de Frey, Alfred Brown, and Ferdi Camisani-Calzolari



Don Ross-Watt, Dirk van Niekerk, and Mavis Hermanus  
(Brigadier Stokes Award winner)



Jeannette McGill (President, Geological Society  
of South Africa) and Mike Solomon



Richard and Helen Minnitt, Helen and Neil Roman  
(President, Mine Ventilation Society of South Africa)

## Students





UNIVERSITY OF THE  
WITWATERSRAND,  
JOHANNESBURG

## Size

It matters! Our high-level academic staff offers specialist higher degrees and produces the largest number of graduates in the English-speaking world.

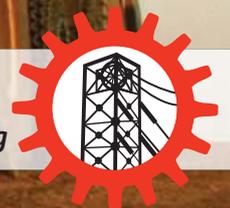
## Substance

Our accredited world-class programmes influence South Africa, Africa and the World. The School is student-centred and academically relevant with defined fields of mining. We bring the environment to our students.

## Style

Our multi-disciplinary and specialist postgraduate programme leads to sustained research output, facilitating regular step changes in industry.

**School of Mining Engineering**  
*University of the Witwatersrand, Johannesburg*



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# Annual report

FOR THE YEAR ENDED 30 JUNE 2016

## Council for 2015/2016

**President**  
R.T. Jones

**President-elect**  
C. Musingwini

### Vice-Presidents

**Senior**  
S. Ndlovu

**Junior**  
A.S. Macfarlane

**Immediate Past-President**  
J.L. Porter

**Honorary Treasurer**  
C. Musingwini

**Co-opted Member**  
I.M. Mthenjane

### Members of Council

N. Bagirathi	D. Munro
N.A. Barcza	J.C. Ngoma
R.D. Beck	G. Njowa
Z. Botha	S.J. Ramokgopa
J.R. Dixon	M.H. Rogers
V.G. Duke	A.G. Smith
M. Dworzanowski	G.L. Smith
F.M.G. Egerton	M.H. Solomon
I.J. Geldenhuys	J.D. Steenkamp
M.F. Handley	M.R. Tlala
H.E. James	H.J. Tluczek
W.C. Joughin	D. Tudor
G.V.R. Landman	D.J. van Niekerk
T.M. Mmola	W.H. van Niekerk
M. Motukua	

### Branch Chairmen

Botswana Branch	L.E. Dimbungu
DRC Branch	S. Maleba
Johannesburg Branch	I. Ashmole
Namibian Branch	N.M. Namate
Northern Cape	C.A. van Wyk
Pretoria Branch	P. Bredell
Western Cape Branch	A. Mainza
Zambian Branch	D. Muma
Zimbabwean Branch	S. Ndiyamba
Zululand Branch	C.W. Mienie

### Past-Presidents serving on Council

N.A. Barcza	G.V.R. Landman
R.D. Beck	J.C. Ngoma
J.R. Dixon	S.J. Ramokgopa
M. Dworzanowski	M.H. Rogers
F.M.G. Egerton	G.L. Smith
H.E. James	W.H. van Niekerk

## Key objectives of the Institute

*To initiate and give effect to the means whereby the requirement for technology and scientific knowledge of the minerals and metals section of the southern African economy is satisfied; and to represent and promote the interests of its members.*

## Arrangement of this Report

In accordance with the current management policy, this report on the activities of the Institute is presented under eight main headings:

1. Interests of Individual Members
2. Technical Meetings
3. Publications
4. Regional Development
5. Engineering Science and Technology in South Africa
6. State Liaison
7. International Liaison
8. Management and Administration.

## 1. Interests of Individual Members

**Portfolio Holder: J.L. Porter**

Last year I made a rather prophetic statement: ‘... *the Institute has had perhaps one of the more successful years in its 121-year history*’. This, of course, was from the perspective of membership numbers. As at the end of the 2016 year, total membership across all categories stood at 4781 representing a decline of only 0.25% year-on-year (Table I and Figure 1). Of this number, 3258 are based in South Africa and a further 964 from our country branches (Table II). The balance is made up of members scattered across the globe. As last year, we continue to see strong growth in our more established country branches in Zimbabwe and Zambia, with a steady increase of membership in the newer branches in Namibia and Botswana.

Table I

### Total SAIMM membership analysis and year-on-year-change

Grade	Number	2016 vs 2015
Fellow	400	-12
Life Fellow	7	-
Honorary Fellow	2	-
Honorary Life Fellow	51	-2
Retired Fellow	148	+9
Member	1657	-45
Life Member	1	-
Retired Member	102	+6
Associate	1090	-86
Retired Associate	12	-
Company Affiliate	123	-1
Student	1188	+119

# Annual report

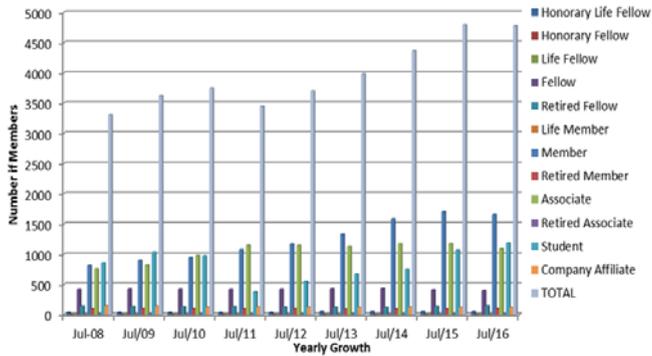


Figure 1—South African membership annual growth

Table II

### Country branch membership analysis for 2016

Botswana	62
DRC	28
Namibia	75
Zambia	195
Zimbabwe	604
Total	964

Student membership across the region remains robust at just under 25% of total membership. This significant percentage remains a cornerstone strategy for the long-term health of the Institute.

However, the strong student numbers mask a worrying decline in both Associate and full Members of the Institute (bearing in mind that Students do not contribute towards membership fees.). This clearly reflects the stress that the mining industry has been under for some time, and specifically that many companies are no longer sponsoring their employees' membership of professional bodies such as the SAIMM. Unlike our sister organizations in other geographies, we do not have an industry professional association that requires membership of the Institute – this is managed through ECSA. Therefore, this portfolio has to continually seek ways of growing our membership base (students) as well as offering value for money to our membership – I will comment further on this in a moment. In addition, I am pleased to report that Council continues to encourage the initiative of offering support to our members that are financially stressed, either through deferred fees or, in exceptional cases, by waiving the annual fee.

The Northern Cape and DRC branches have been affected by the downturn in the mining industry and will continue to need support over the next year or two.

At an SAIMM strategy session earlier in the year we were forced to take a very hard look at the affordability of many of the SAIMM's projects due the constrained revenues from our traditional sources. As mentioned in previous reports, the commitment of the SAIMM to the country branches cannot be compromised due to the longer term damage that would be sustained by the Institute. However, we have decided not to extend the contract of our Country Branch Manager (the post remains vacant). At this stage it would be remiss of me not to

recognize the excellent work that Malcolm Walker has done in this portfolio during his term of office. He should be congratulated by all, specifically for the increase in student membership across the region.

Furthermore, we have reduced the amount of travel required of our branch officials and SAIMM staff. In order to compensate for these decisions, it is envisaged that in the next year we will develop and implement a formal approach to the training of newly elected branch officials. It is anticipated that by structuring this training appropriately, we will be able to maintain our commitment to the branches, facilitate smooth transitions between changes in committee members, and enhance the professionalism of the organization.

The working agenda of the Membership Committee has been modified over the past year. The Secretariat has streamlined the membership application process to the extent that it requires less administrative time. For this we are greatly appreciative of the SAIMM Membership team. This has freed up time to consider other aspects pertaining to the interests of our members. These include the following activities:

- Re-defining membership benefits in conjunction with our sister institutes around the world to ensure that reciprocity is more visible and effective
- Ongoing updates of the by-laws relating to membership
- Actively focusing on upgrading members to higher membership grades
- Maintaining our role within ECSA
- Re-design of the SAIMM website to further improve application and payment efficiency
- Monitoring of the membership 5 Star Incentive Programme
- Recognizing our newly elected Fellows at the annual banquet
- Creating an electronic membership archive to ensure easier access and prevent loss of documentation
- Assisting the Young Professionals Council in the implementation of the Mentorship Programme.

I wish to extend my personal thanks to the members of the Committee for their commitment and support.

It is with great sadness that we have to report the passing of a few of our members, many of whom have played pivotal roles in the southern African mining and metallurgical industries.

Deceased members	Election date	Grade
Richard Peter Mohring	4 May 1971	Honorary Life Fellow
David Lester Jackson Lawrence	21 Apr. 1989	Retired Fellow
Thomas Edwin Green	28 Aug. 1967	Retired Member
Andrew Simon Wood	15 Oct. 2004	Fellow
Brian Moore	11 Nov. 1960	Retired Fellow
James Bethel	18 Nov. 1994	Member
Dirk Theunis Fourie	21 Feb. 1968	Retired Fellow
Prince Charingira	16 Jul. 2010	Associate
Gerrit Johannes Cornelius Strydom	19 Apr. 1996	Member
David Rankin	9 Nov. 1956	Retired Fellow
Robin Edmund Robinson	14 Oct. 1960	Honorary Life Fellow
Robert Carruthers Bertram	10 Sep. 1954	Retired Fellow
Benjamin Higginson Leinster Leach	10 Nov. 1950	Retired Fellow

## Annual report

There is no doubt that to maintain the twin objectives of membership growth and fee collection in these times is going to be a real challenge for the coming 2017 year. Membership and conference fees are maintained well within inflation parameters to ensure that our members continue to get value for their fees. On behalf of the Membership Committee and of this Portfolio, we will strive to support our incoming President and Council in meeting their objectives and seeking new ways to support our members.

### 1.1 Membership Committee

J.L. Porter, Chairman

N.A. Barcza

R.D. Beck

J.A. Cruise

J.R. Dixon

A. Garbers-Craig

G.V.R. Landman

R.P. Mohring\*

J.C. Ngoma

R.G.B. Pickering

\* Deceased

S.J. Ramokgopa

M.H. Rogers

D.A.J. Ross-Watt

G.L. Smith

T.R. Stacey

O.K.H. Steffen

J.N. van der Merwe

D.J. van Niekerk

M. Woodhall

#### Membership

The SAIMM membership comprises engineers, metallurgists, chemists, physicists, geologists, certificated managers, and technikon diplomates, and other disciplines, all of whom have an interest in the fields of mining, extractive metallurgy, metals technology, and other related areas.

#### Requirements for Corporate membership

HONORARY LIFE FELLOW: An Honorary Life Fellow shall be a person whom the Institute specifically desires to honour in consideration of services rendered to the Institute, to science, or to industry. Honorary Life Fellows shall have all the privileges of Corporate Members.

- The election of an Honorary Life Fellow shall take place at a Council meeting, due notice having been given at the preceding Council meeting of Council's intention to nominate a person as an Honorary Life Fellow. The election shall require the majority vote of Corporate Members of Council present at a Council meeting
- The election of an Honorary Life Fellow shall be announced at the following Annual General Meeting of the Institute
- An Honorary Life Fellow will have all membership fees and subscriptions waived.

FELLOW: A candidate for admission to or transfer into the category of Fellow shall:

- Be at least 35 (thirty-five) years of age
- Have, for a period of at least 5 (five) years, been practising in a senior technical position in mining or metallurgical undertakings, or in governmental, educational, or research organizations concerned with those industries, or
- Have, for a period of at least 5 (five) years, been practising as a consultant in the skills of mining and metallurgy, and
- Be practising his/her profession at the time of application, satisfy Council that he/she is a fit and proper person to

become a Fellow, and Council shall be satisfied that his/her qualifications, training, and technical experience justify such professional status, and

- Have been a Member of good standing for 5 (five) years and have promoted the interests of the SAIMM through:
  - Serving on committee structures, and/or
  - Publishing in the SAIMM Journal or conference proceedings, and/or
  - By other means acceptable to Council.

MEMBER: A candidate for admission to or transfer into the category of Member shall:

- Be at least 25 (twenty-five) years of age
- Have, for a period of at least 2 (two) years, been practising in a responsible or senior technical position in minerals and metals industry undertakings or in governmental, service, educational, or research organizations concerned with those industries, or
- Have, for a period of at least 2 (two) years, been practising as a consultant in the minerals and metals industries, and
- Be practising his/her profession at the time of his/her application, satisfy Council that he/she is a fit and proper person to become a Member, and Council shall be satisfied that his/her qualification, training, and technical experience justifies such professional status.

#### Requirements for Non-corporate membership

COMPANY AFFILIATE: Companies involved in or associated with the mining and metallurgical industries are eligible for admission to the category of Company Affiliate.

HONORARY FELLOW: Honorary Fellows shall be persons of distinction in public service, science, or the arts and shall be elected or re-elected by Council for the current year. They shall enjoy all the privileges and rights of members, except those of holding office and voting.

ASSOCIATE: A candidate for admission into the category of Associate shall:

- Be at least 18 (eighteen) years of age, and
- Be involved in minerals and metals industry undertakings or in governmental, service, educational, or research organizations concerned with those industries, but not meet requirements to be registered as a Corporate Member
- Satisfy Council that he/she is a fit and proper person to become an Associate Member.

STUDENT: A candidate for admission into the category of Student shall:

- Be a person in the third or further year of being educated or trained in a manner approved by Council to occupy a technical position or associated with the minerals or metals industries
- Satisfy Council that he/she is a fit and proper person to become a Student Member
- Remain a Student Member only while he/she is being educated in a manner approved by Council
- Confirm their membership at the beginning of each academic year by submitting proof of registration at their applicable tertiary institution. Failure to submit proof of registration will result in termination of membership

Table I

## Summary of new applications and membership movements for 2015/2016 and comparison of membership grades and total membership 2015/2016

Membership grade	Members July 2015	New members	Transfers in	Transfers out	Reinstatements	Resignations	Deceased	Struck off	Net gain/(loss)	Members June 2016
Honorary Life Fellow	53	0	3	0	0	0	-3	0	0	53
Honorary Fellow	2	0	0	0	0	0	0	0	0	2
Life Fellow	7	0	0	0	0	0	0	0	0	7
Fellow	412	0	9	-18	0	-4	-3	-6	-22	390
Retired Fellow	139	0	17	-1	1	0	-1	0	16	155
Life Member	1	0	0	0	0	0	0	0	0	1
Member	1 702	117	30	-11	31	-17	0	-32	118	1 820
Retired Member	96	0	3	0	0	0	-1	0	2	98
Associate	1 176	114	21	-31	2	-14	0	-89	3	1 179
Retired Associate	12	0	0	0	0	0	0	0	0	12
Student	1 075	706	1	-15	1	0	0	-372	321	1 396
Company Affiliate	124	3	0	0	0	-1	0	-6	-4	120
Total	5 233	940	84	-76	35	-36	-8	-505	434	5233

- Not remain a Student Member after the end of the Institute's financial year in which he/she attains the age of 28 (twenty-eight) years. Council may relax the provisions of this clause in such cases as it considers appropriate.

### Membership roll

Members of the Institute are divided into Corporate and Non-Corporate Members, all of whom are entitled to attend and speak at meetings. Only Corporate Members are entitled to vote. All applications for membership or transfer require one proposer and one seconder.

**RESIGNATION:** A Member may resign from the Institute by sending his or her written resignation to the Secretary together with payment of any monies due.

**RETIRED MEMBERSHIP:** A Fellow or Member who has *bona fide* retired from active business may retain membership at a reduced subscription providing he or she has been a member for 20 years. Members can contact the Secretary to establish the number of years of service prior to submitting a written request for Retired Membership to the Institute.

**STUDENTS:** A candidate may remain a Student Member only while he or she is being educated or trained in a manner approved by the Council.

When he or she no longer qualifies as a Student Member, he or she shall automatically be transferred to the category of Associate. Students are reminded to forward a copy of their degree certificates to the Institute on graduation.

A candidate may not remain a Student Member after the end of the Institute's financial year in which he or she attains

the age of twenty-eight years, unless the Institute receives written confirmation from the university or technikon that the Student Member is still a full-time student.

**CHANGE OF DETAILS:** It is essential that members contact the Institute without delay about change in designation, change in employer, payment address, or change in postal address. Without this the communication link to members is broken. Also, members must ensure that, where subscriptions are paid by a company, the Institute has on record the correct payment address.

### Benefits of membership

Individuals derive various benefits from membership of the Institute:

- Contact with fellow members
- Special reduced fees when attending congresses, symposia, colloquia, conferences, schools, discussion groups, etc.
- Notices of events promoting technology transfer, which also satisfy the need for continuing education
- A monthly *Journal* with a balanced content and of high technical standard, which serves as a communication medium to keep members informed on matters relating to their professional interests
- Participation in technical excursions, banquets, and other social events, which create further opportunities for professional association and fellowship
- Tax deduction of membership fees in most cases
- Reduced registration fees for professional registration through the Engineering Council of South Africa.

Companies that become Members of the Institute:

## Annual report

- ▶ Benefit from the opportunities to exchange knowledge, particularly about new developments and research
- ▶ Receive the Institute's publications of international conferences held in South Africa, as well as monographs on a variety of subjects and regular copies of the monthly *Journal*
- ▶ Are entitled to send two non-member employees to mining and metallurgical schools, colloquia, congresses, visits, and excursions at Member rates
- ▶ Receive newsletters and notices about all Institute activities
- ▶ Benefit from the fact that Company Affiliateship is tax deductible
- ▶ Have ample opportunity to send delegates to attend technical meetings to obtain information and to benefit from the experience of others.

### 1.2 Young Professionals Council (incorporating the Career Guidance and Education Committee)

T.M. Mmola, Chairman  
N. Bagirathi, Vice-Chairman  
A.S. Nhleko, Treasurer  
V.G. Maseko, Secretary

W. Banda	M.S. Motlhabane
R. Blunden	T. Mulambo
G. Dabula	S. Ndlovu*
D.M. Gama	L. Nene
D.E.P. Klenam	M. Nesor
E.S. Links	K. Ramasia
J.A. Luckmann*	S.M. Rupprecht*
S. Maharajh	C. Setuke
G. Mahlong	A.G. Smith*
M. Malatse	L. Zombene

\*Career Guidance and Education Committee members

\*\* SANCOT Observer

With 2015–2016 being the first term of the Young Professionals Council (YPC), the strategy was to direct efforts on building internal systems, processes, and capacity for the YPC. This involved setting up three working groups: Education, Career Guidance, and Enterprise, to manage the activities of the YPC. Each working group identified areas where the YPC could quickly make an impact on the lives of young professionals in the minerals industry.

#### Career Guidance

It is crucial that learners have access to accurate information and meaningful career guidance so that they can make well-informed career choices. Unfortunately, quality career guidance and information are often not readily available to learners from underprivileged communities. This is a need that the YPC fulfils as part of its community outreach. On 23 April 2016, the YPC gave career guidance to close to 300 grade 9 to 12 learners from one of the most underprivileged communities in Pretoria North (Ga-Rankuwa) on the different career opportunities available in the minerals industry. The YPC also continued to support the Sci-Bono Discovery Centre's initiative to give career guidance to Gauteng learners in grades 9 to 12 by participating in the Engineering Focus Week (24 May 2016).

#### Education Support

A big challenge for students is meeting the costs of tertiary education. The SAIMM has played an important role in addressing this problem through the Scholarship Trust Fund (STF). In this year, innovative fundraising initiatives by the YPC that included a raffle at the annual gala dinner and an online fundraising campaign led to a greater awareness about the STF and an unprecedented number of individual donations. Unfortunately, the goal of raising R500 000 in the year was not realized, but efforts to support this worthy cause continue.

#### Job Placement

Unemployment has become the highest concern for young professionals in the minerals industry. In response to the challenge of finding employment in the current environment, the YPC developed a web-based service to connect potential employers with job-seeking graduates. The service consists of a database of graduates to whom the SAIMM is able to send information about work opportunities. Since its inception, three work opportunities have been made available to graduates and interest in the service is growing. Plans are underway to develop an online portal to support this service.

#### Mentoring

Young professionals face numerous challenges in their careers. Mentoring is recognized as one of the most effective means of developing talent. A mentoring programme has been introduced to link young professionals with experienced and knowledgeable mentors to provide consistent support, guidance, and concrete help on a one-to-one basis to enhance their career development. The programme has 37 registered mentors and 67 registered protégés.

#### Information Dissemination

The YPC continues the tradition of the SAIMM by organizing informative conferences and colloquia. Successful events held in the year are the revived Career Day and the long-running Student Colloquium, which for the first time was run alongside the Young Professionals Conference. These events, which have in the past been organized by different committees of the SAIMM including the YPC's predecessor, the Career Guidance and Education Committee, have now been consolidated under the YPC portfolio.

#### Stakeholder Engagement

Although the strategic focus for the YPC was on internal capacity-building, external stakeholders play a critical role in the mission of the YPC. The YPC has been involved in several activities to promote the profession and the SAIMM. The YPC has established strong rapport with the tertiary education institutions, and as such has honoured several invitations to participate in student-organized events. The YPC is also building a good standing with other bodies, such as Engineers Without Borders (EWB-SA), as a leading voice for young professionals in the minerals industry. The YPC regularly publishes a newsletter that goes out to all SAIMM members to share information about the activities of the YPC. These and other initiatives have created a greater awareness of and interest in the SAIMM amongst a younger population base in the minerals industry.

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## 1.3 Promotion of the SAIMM

### Portfolio holder: R.T. Jones

This year has been an extremely challenging one for the global mining industry, involving job losses, closures, low demand, and low metal prices. The SAIMM has not been alone in feeling the impact of the downturn in the industry. Societies similar to the SAIMM have experienced significant losses, and some have had to retrench staff. At the SAIMM, there has had to be some belt-tightening, but we have continued with all of our core activities and have even been able to provide some additional benefits to our members.

### Publications and website

The dissemination of technical information remains central to the activities of the Institute. The SAIMM's policy of providing free and open access to our *Journal* papers and conference proceedings is highly appreciated by users of our website. During the year, the website was upgraded substantially, with the intention of making it more responsive and better formatted when viewed using a wide range of devices including computers, tablets, and cellphones.

The *Journal* has continued to be published monthly. A three-month trial of distributing the *Journal* electronically was undertaken successfully. This has allowed a wider distribution of the *Journal* (now including student members) and has met the requests of numerous members who indicated a preference for electronic distribution. This also allows speedier and more reliable delivery than the postal services are able to provide. We have not done away with printed copies, as we know that a number of members (and some libraries) prefer a paper copy. However, we do hope that partial replacement of print with electronic copies will reduce the cost of printing and postage.

### OneMine.org and technical library

Through our participation in the Global Mineral Professionals Alliance (GMPA), together with international societies such as the AusIMM (Australasia), CIM (Canada), IIMP (Peru), IOM3 (UK), and SME (USA), we are able to offer our members free access to the more than 100 000 technical papers that are stored in the OneMine.org repository. This searchable database provides a very significant benefit to our members. The SAIMM has a representative who sits on the board of OneMine.org. During the past year, we have provided our members with the additional new benefit of access to the technical library, which has amalgamated the collections of the former Anglo American and Chamber of Mines libraries. Members are able to receive up to 10 articles per month from the technical library by e-mail at no charge.

### Global Mineral Professionals Alliance (GMPA)

Our participation as a founding member of the GMPA enables our members to enjoy reciprocal benefits from the other participating societies, including reduced rates for a number of international conferences. GMPA member societies meet annually to exchange relevant information and to attempt to avoid scheduling conflicts regarding international events. Operating data is exchanged between the societies to allow them to benchmark themselves against their peers.

### Technical conferencing

The Mining and Metallurgy Technical Programme Committees

(TPCs) have continued doing a very good job of sourcing and overseeing conferences on a variety of topics of importance to the minerals industry. Events were held in South Africa, Botswana, Zambia, and Zimbabwe. Twelve conferences were held during the past year, and a number of these were joint collaborations between the two TPCs. Communication between these committees was enhanced by holding shared meetings on a quarterly basis. Formal proceedings of high-quality peer-reviewed papers continue to be published for most of the larger conferences; however, electronic copies are now provided to delegates as part of their registration package, and printed copies are printed on demand only.

Unfortunately, there has been a noticeable decrease in the number of conference delegates from mining companies, as a result of the harsh economic conditions causing discretionary spending on conference attendance to be decreased. However, despite the current economic circumstances, a number of companies have continued to provide sponsorship for events, thereby keeping the costs for delegates quite reasonable. The SAIMM is very grateful for the support of these industrial partners.

### Membership

Membership of the SAIMM has continued to grow, and during this year reached a peak of 4917. Our members are based in more than 50 countries, although the majority hail from southern Africa. During this past year, a new website-based membership system was introduced to provide greater flexibility and to allow members to check and update their own personal data online. It was recognized that a number of unemployed members required support and, as a caring organization, SAIMM has deferred their membership fees upon request.

### Professional associations

On the local front, the SAIMM has maintained discussions with a number of organizations related to the minerals industry, by means of attending annual general meetings and other annual functions, as well as by having reciprocal observer status at council meetings. These associations include the:

- ▶ Geological Society of South Africa (GSSA)
- ▶ Association of Mine Managers of South Africa (AMMSA)
- ▶ Mine Metallurgical Managers Association (MMA)
- ▶ Institute of Mine Surveyors of South Africa (IMSSA)
- ▶ Mine Ventilation Society of South Africa (MVSSA)
- ▶ South African Colliery Managers Association (SACMA)
- ▶ Southern African Coal Processing Society (SACPS)
- ▶ Fossil Fuel Foundation (FFF)
- ▶ South African Institution of Chemical Engineers (SAICHE-ICHEME)
- ▶ South African Institute of Electrical Engineers (SAIEE)
- ▶ South African Academy of Engineering (SAAE).

The SAIMM has continued to support the activities of the Engineering Council of South Africa (ECSA) in recognition of the importance of globally recognized professional registration. SAIMM members participate in the Professional Advisory Committees (PACs) for Mining Engineering and Metallurgical Engineering. Discussions are currently underway between ECSA and the voluntary associations (such as the SAIMM) regarding the principles that govern the relationships between



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1992	J. Lurie	
1993	No award	
1994	B.C. Alberts	
1995	R.D. Beck	H.E. James
	P.R. Janisch	
1996	R.J. Dippenaar	H.G. Mosenthal
	J.S. Freer	
1997	J.A. Cruise	
1998	D.A.J. Ross-Watt	
1999	No award	
2000	N.A. Barcza	J.R. Dixon
	R.P. Mohring	
2001	M.H. Rogers	D.J. van Niekerk
2002	L.A. Cramer	R.F. Sandenbergh
	C.T. O'Connor	J.H. Selby
2003	A.A.B. Douglas	P.J. Knottenbelt
2004	No award	
2005	F.A. Camisani-Calzolari	
2006	T.R. Stacey	
2007	No award	
2008	E.U.H. Sachse	
2009	I. Walton	
2010	R.T. Jones	
2011	No award	
2012	No award	
2013	No award	
2014	G.V.R. Landman	R.G.B. Pickering
	A.S. Macfarlane	
2015	O.K.H. Steffen	M.F. Handley
2016	R.C.A. Minnitt	S.J. Ramokgopa
	J.L. Porter	G.L. Smith

### Brigadier Stokes Memorial Award

The Brigadier Stokes Memorial Award, which takes the form of a platinum medal, is awarded to an individual for the very highest achievement in the South African mining and metallurgical industry, and is not necessarily based on technical expertise.

The Award was established in 1980, and the previous recipients were as follows:

1980	H.F. Oppenheimer
1981	W. Bleloch
1982	F.G. Hill
1983	A.W. Whillier (posthumously)
1984	D.G. Krige
1985	R.E. Robinson
1986	M.D.G. Salamon
1987	T.F. Muller
1988	W.J. (Wim) de Villiers
1989	R.A. Plumbridge
1990	W.G. Boustred
1991	P. du P. Kruger
1992	E. Pavitt
1993	D.A. Pretorius
1994	H. Wagner
1995	O.K.H. Steffen
1996	B.E. Hersov
1997	D.W. Horsfall (posthumously)
1998	B.P. Gilbertson
1999	L. Boyd
2000	A.H. Mokken

2001	T.L. Gibbs
2002	J. Ogilvie Thompson
2003	P.V. Cox
2004	H.J. Smith
2005	P. Motsepe
2006	G.T. van Rooyen
2007	D.H. Laubscher
2008	T.R. Stacey
2009	C.J. Fauconnier
2010	C. O'Connor
2011	B.C. Alberts
2012	R.P. Mohring
2013	H.R. Phillips
2014	R.M. Godsell
2015	S.A. Nkosi

This year the award is made to M.A. Hermanus for her outstanding contribution to the industry over many years.

### SAIMM 50 Year Club

The Institute established the 50 Year Club in 1989 to recognize the faithful and loyal support of its senior members with 50 years' unbroken membership. They become members of the club on the 50th anniversary of their joining the Institute. Their names are published each year in the Annual Report and they are presented with a gold lapel badge on a suitable occasion.

There are no fees, and the only obligation of members is to wear their lapel badges with pride and affection at all meetings of the Institute. The present members of the club are as follows:

#### Year to

Year to	Member
1924	E.C. Polkinghorne*
1926	R.M. Martin*
1927	W. Allen*
1930	E.T. Dunstan* (posthumously)
	P.L. Ward*
1931	F. Bowdler*
1932	J.E. Laschinger*
1933	F.D. Cartwright* E.R.C. O'Connor*
	C.H. Coxon* B.M. Roberts*
	J. Levin* A.A. von Maltitz*
	D.D. McWilliam* T. Waterman*
1934	A.C.M. Cornish-Bowden* J.W.V. Mortleman*
	H.E. Cross* K. Rood*
	E.F. Laschinger* A. Siff*
	E. Margo O. Weiss*
1935	O.B. Swallow*
1936	O. Deane* A.H. Mokken*
	T.L. Gibbs* H.L. Munro*
	R.C.J. Goode* R.M.F. Seawright*
	F.G. Hill* A.C. Pigott*
	D.M. Jamieson* J.S. van Zijl*
	D.J. Rogers* L. Walter*
1937	W. Bleloch* J.J. Klein*
	L.A. Bushell* C.D. Storrar
	K.W. Findlay*
1938	V.C. Barnes* C.A. McKechnie*
	E.T.S. Brown* J.A. Nixon
	R.S. Cooke* E. Popplewell*
	J.K.E. Douglas C.G. Sowry*

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1939	A.L.A. Forder* G. Armstrong-Smith* D.E.R. Ayres* E.H.D. Carman W.G.H. Jackson* T.A. Newman	E.W. Thiel* R.S. Pearson* D.C.J. Squirrell* R.F.J. Teichmann* I.S. van Eyssen* S.J. Venning* G.D. Getliffe*	J.J. Blom R. Campbell	R.C. More O'Ferrall N.C. Officer	
1940	L.D.C. Bok* A.W.L. Brereton*	G.G. Stanley* D. de V. Oxford*	1958	J.F. Dear* R.H. Swan	B.S. Tatterson P.J. van der Walt
1941	A.H.H. Davison* D.J. Forder A.R.C. Fowler* H.F.W. Ketelbey* J.D. McNamara* T.F. Muller*	E. Pavitt A.C. Petersen* E.R. Rudolph* P.W.J. van Rensburg*	1959	H.E.K. Allen D.C. Brink G.D. Louw	H.A.G. Slater G.T. Van Rooyen
1942	R.E. Burnton* R.C. Espley-Jones* N.M. Hayne* R.T. Naudé*	O.L. Papendorf* V.O. Steed J.E. van Leeuwen* W.C. Walmsley* R.P. Plewman*	1960	R. Hemp G. Joynt B. Moore R.E. Robinson* C. Roper	C.T. Shaw L.W.P. van den Bosch* H. von Rahden M. Wishart
1943	D.J. Molony* J.D. McMorran*	V.M. Reinecke* A.S. Swartz A.H. Taute* P.B. Weehuizen* K.E. Steele*	1961	W.B. Evans R.A. Featherstone I.R.H. Forrest J.S. Freer B.W. Holtshousen	G.S. Lee B.J. Love P.J. Muller G.J.C. Young W.J.G. Young
1944	A.F. Dick R.B. MacGillivray* L.J. Prince* J.F. Reid*	J.D. Pollard V.C. Robinson* A.N. Shand* G.R. Still J. Pope* N.A. Stacey J.A. Tyser	1962	S.I. Du Preez P.J. Heystek	E. Schmid
1945	J.L. Curtis* E.T. Pinkney*		1963	L. Anderson H.K.R. Cahnbley G.C. Clatworthy R.E.F. Cowley J.A.J. De Cuyper	J.N. Gallie J.J. Geldenhuys T.J. Kotze A.H. Munro A.G. Netto A.W. John A. Simon
1946	W.I. Spence		1964	J. Douglas K. Imre	W. Mitchell D.I. Ossin M.H. Rogers E.H.J. Stoyell R.S. Traviss* J.W. Walls I.C. Watson J.C.M. Wethmar J.P. Loo
1947	G.H. Grange W.B. Howe J. Marr-Levin C.J. Parr*		1965	P. Andersson J.A. Cruise F.S.A. De Frey F.M.G. Egerton F.Fenwick M.R. Fuller-Good P.G. Gaylard J.P. Hoffman J.P. Loo	
1948	D.F. Foster M.H. Grusd* P.A. Laxen* G.Y. Nisbet				
1949	G.P. Bennett* J.F. Curtis* O. Davel				
1950	D.F. Grieve B.E. Hersov D.G. Maxwell	R.P. Plasket* V.C. Ward			
1951	D.G. Krige* B.H.L. Leach M.J. Martinson W.D. Ortlepp*	N.C. Pope W.T. Ruhmer T. Zadkin*			
1952	A.N. Brown M.J. Deats W. Lurie* N. Martincevic	E.P. Mortimer D.J. Murphy H.J. Stucke* R.G. Williams G.D. Tainton J. Uys* N. Zolezzi			
1953	B.G. Fordyce G. Langton* A.A. Sealey	R.B.W. Wiggill G.R. Parker W.B. Parker			
1954	R.C. Bertram				
1955	R.A.O. Chelius* S.P. Ellis C.T. Fenton	M.A. Madeyski* D. Rankin G.C. Thompson			
1956	G.A. Brown D.R. Chelius M.F. Dawson L.M. Falcon				
1957	K. Babich	A.M. Edwards			

\* Deceased since becoming members of the Club

### The Danie Krige Memorial Award

Following discussions at Office Bearers and Council during 2013 it was agreed to honour the memory and contribution to the minerals industry made by the late Professor Danie Krige.

It was agreed, amongst other activities, to make an annual award of a Danie Krige medal for a qualifying geostatistics paper published in the SAIMM Journal of the previous year.

The recipients of the award for their paper published in the June 2015 *Journal* are A. Cornah and E. Machaka.

### Gold and Silver Medals

Papers published in the *Journal* from March 2015 to February 2016 by members of the Institute were considered for medals.

### Gold Medals

Gold medals are awarded for papers that are of a world-class standard, and judged to be publications that will become key references in their mining or metallurgical field in the future.

Gold Medals were awarded to:

L.F. Contreras for his paper published in the July 2015 issue of the *Journal* entitled 'An economic risk evaluation approach for pit slope optimization'.

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D.K. Chibwe, G. Akdogan, G.A. Bezuidenhout, J.P.T. Kapusta, S. Bradshaw, and J.J. Eksteen for their combined papers published in the May 2015 issue of the *Journal* entitled:

'Sonic injection into a PGM Peirce-Smith converter: CFD modelling and industrial trials'  
and

'Modelling of fluid flow phenomena in Peirce-Smith copper converters and analysis of combined blowing concept' by D.K. Chibwe, G. Akdogan, P. Taskinen, and J.J. Eksteen. As non-members, D.K. Chibwe, G.A. Bezuidenhout, J.P.T. Kapusta, and P. Taskinen, will receive certificates of merit.

### Silver Medals

Silver medals are awarded for papers that make a major contribution to the professions of mining and metallurgy and to the prestige of the Institute.

Silver Medals were awarded to:

J. Hager, V.S.S. Yadavalli, and R.C.W. Webber-Youngman for their paper entitled:

'Stochastic simulation for budget prediction for large surface mines in the South African mining industry' published in the June 2015 issue of the *Journal*.

As a non-member, V.S.S. Yadavalli will receive a certificate of merit.

R.H. Matjie, Z. Li, C.R. Ward, J.R. Bunt, and C.A. Strydom for their paper published in the February 2016 issue of the *Journal* entitled: 'Determination of mineral matter and elemental composition of individual macerals in coals from Highveld mines'.

As non-members, R.H. Matjie, Z. Li, C.R. Ward, and C.A. Strydom will receive certificates of merit.

Q.G. Reynolds, for his paper published in the May 2015 issue of the *Journal* entitled: 'Interaction of dust with the DC plasma arc – a computational modelling investigation'.

J.D. Steenkamp, P.C. Pistorius, and M. Tangstad, for their combined papers entitled:

'Chemical wear analysis of a tap-hole on a SiMn production furnace' published in the March 2015 issue of the *Journal*.

and

'Insights into the potential for reduced refractory wear in silicomanganese smelters' by J.D. Steenkamp, P.C. Pistorius, and J. Muller, published in the January 2016 issue of the *Journal*.

As a non-member, M. Tangstad will receive a certificate of merit.

### Student Prizes

Prizes were awarded to the following students and were presented at faculty prizegiving ceremonies held at the respective universities.

The prize winners were as follows:

#### University of the Witwatersrand

Mining Engineering	G. Sithole
Metallurgical Engineering	J. Malatji

#### University of Pretoria

Mining Engineering	G. Lindeque
Metallurgical Engineering	N. Snyman

#### University of Johannesburg

Mining Engineering	A. Ramovha
Metallurgical Engineering	P. Twite

#### University of Cape Town

Mineral Processing	J.L. Roberston
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#### University of Stellenbosch

Mineral Processing	C. Broeksma
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#### Cape Peninsula University of Technology

Mineral Processing	K.J. Kabamba
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The prizes for the universities of Cape Town and Stellenbosch and the Cape Peninsula University of Technology will be awarded at the Western Cape Branch Annual General Meeting on 17 August 2016

In addition, the Western Cape Branch also awards two Outotec Postgraduate Scholarships for students conducting research in the area of sustainable mineral processing.

There was no award this year.

#### SAIMM 5 Star Incentive Programme

The SAIMM 5 Star Incentive Programme was introduced in 2015 to thank members who contribute to the growing membership of the SAIMM and to provide additional benefits to Fellows and Members of the SAIMM.

The Top 5 proposers are:

J. Steenkamp  
D. Muma  
M. Tlala  
N. Schoeman  
W. Kutekwatekwa.

The Top 5 referees of papers published in the *Journal* are:

M. Handley  
T. Stacey  
M. Dworzanowski  
S. Rupprecht  
G. Lane.

The authors who have submitted and published the most number of papers in the *Journal* are:

J. Bunt  
J. Claassen  
R. Webber-Youngman.

#### Top Advertiser in the Journal

The award for the *Most Supportive Advertiser* in the *Journal* is to be made annually by the SAIMM and it is the Institute's way of recognizing the continued and loyal support of those companies that advertise in our *Journal*. The award is made not only on the strength of the amount of money spent by an advertiser, but also on factors like general cooperation, meeting of deadlines, and the timely settling of accounts. Our advertisers make a major contribution to the Institute's ability to provide our members and associates with a quality *Journal*.

This year's award winner is Elbroc.

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### 1.5 SAIMM Scholarship Trust Fund

J.R. Dixon, Chairman  
R. Mohring, Vice-Chairman  
F.M.G. Egerton M.H. Rogers  
A.S. Macfarlane W.H. van Niekerk  
T. Mmola (co-opted from YPC)

The Trust Fund was able to distribute a total of R 284 000 between the eight (8) minerals industry related faculties across the country. Contributions to the Trust Fund by individual members and company affiliates are gratefully acknowledged and will be recognized in the *Journal*. The SAIMM continued its support of the Trust Fund with a contribution of R200 000. The funds are allocated based on the number of minerals industry students in the four years of study at each institution as a percentage of the total of 3204 students.

The role of the Scholarship Trust Fund has become even more important as student numbers continue to rise despite the prevailing economic climate.

During the year the Scholarship Trust Fund was made more visible through the SAIMM website and the payment system was made more easily accessible. Thanks to Tshepo Mmola for his contribution in this regard.

Rick Mohring the Vice-Chair and a long-serving trustee passed away during the year. We acknowledge the tremendous contribution he made to the Trust; we will miss his enthusiasm and positive motivation.

Members are reminded that contributions to the Trust Fund are tax-deductible and can be made on line to the Trust Fund's bank account. (SAIMM Trust Fund, FNB, branch code 251705, account number 62227511286)

We look forward to your continued support.

### 1.6 Banquet Committee

K. Chabedi S. Ndlovu  
R.T. Jones J.L. Porter  
C. Musingwini

The banquet was held on Saturday 5 March 2016 in the Ballroom at the Sandton Convention Centre.

The guest speaker was Mr Johnny Clegg, a South African icon who has recorded and performed with his bands Juluka and Savuka over many decades. Sometimes called *Le Zoulou Blanc* ('The White Zulu'), he is an important figure in South African popular music history, with songs that mix Zulu with English lyrics, and African with various Western European (such as Celtic) music styles.

By combining African music structures with Celtic folk music and international rock sounds, Clegg – together with Juluka and Savuka and as a solo artist – pioneered a new and unique sound, establishing himself as South Africa's biggest musical export, and he gave guests a taste of this at the banquet.

Many favourable comments were received after the function with regard to the entertainment, the food, and the evening in general.

There were three VIP tables and 30 Sponsors' and Members' tables, with 359 guests in total.

## 2. Technical Meetings

Portfolio Holders: R.T. Jones and C. Musingwini

### 2.1 Technical Programme Committee—Mining

D.D. Munro, Chairman  
Z. Bothas, Metallurgy Representative  
A.W. Dougall S.M. Rupprecht  
C.R. Fredericks R. Sivalingum  
W. Joughin C.B. Smith  
D. Limpitlaw G.L. Smith  
J.A. Luckmann A.G. Smith  
A.S. Macfarlane M.H. Solomon  
R.C.A. Minnitt D. Vogt  
C. Musingwini R.C.W. Webber-Youngman  
J.L. Porter M. Woodhall  
S. Pule

The introduction to the Institute on the SAIMM website states: *'The SAIMM is a professional institute with local and international links aimed at assisting members' source news and views about technological developments in the mining, metallurgical and related sectors as well as embracing a professional code of ethics. The SAIMM also attempts to fulfil what it sees as its obligations to the various communities and the environment in terms of the SAIMM's Charter. In addition, the institute is active in bringing together the mining and metallurgical fraternity in terms of research, shared-experiences, education, personnel as well as students.'* ([www.saimm.co.za/about-saimm/about-saimm](http://www.saimm.co.za/about-saimm/about-saimm))

The growth of SAIMM exposure is achieved in two main ways:

- ▶ The publishing of the monthly *Journal* (covered elsewhere in the Annual Report).
- ▶ The convening of conferences, colloquia, and schools.

The Mining Technical Programme Committee (TPC) collaborates closely with the Metallurgical TPC. This year has seen us working even closer through joint quarterly meetings in addition to our monthly mining-specific meetings. It is at these meetings that we discuss ideas for new events, address organizational challenges of conferences and in planning, and also reflect on recent events. These meetings are attended on a voluntary basis by individuals who represent tertiary institutions and are industry role-players. The SAIMM is always eager to expand its talks by having new speakers and topics of discussion. These can be presented by either attendance at the meeting or via e-mail, and we invite you to do so through the office of the SAIMM.

This process has enabled us to deliver 12 mining-related conferences over the past year, attracting a total attendance of over 2704 delegates. Of these conferences, six were mining-specific.

The TPC and Conference committees are aware of the tight financial constraints many of our members and non-members are faced with and have carefully chosen venues that are affordable. Topics are of a nature that are relevant and have managed to attract a wide range of authors to present some of the latest cutting-edge subjects.

- ▶ The year kicked off with the joint hosting of the Copper Cobalt – 8th Base Metals Conference in Zambia, attracting 186 attendees

## Annual report

- ▶ This was followed by the Virtual Reality in Mining 2015 Conference, hosted in the University of Pretoria's new three-dimensional VR laboratory. Although virtual reality is a relatively new tool in mining, the event attracted 74 delegates and many new applications for the technology were highlighted
- ▶ A two day conference on Geostatistics, in memory of Danie Krige, was held in Rosebank in August 2015 and attracted 66 delegates
- ▶ MineSafe has evolved into a 'must-attend' event on the mining calendar, and this year saw a total of 1137 people participating over the three days, the bulk of the visitors attending the industry day on the last day. This being an annual event, we look forward to a great attendance again in the coming year
- ▶ September saw World Gold returning to South Africa at Misty Hills, with 192 attendees
- ▶ Slope Stability 2015 was hosted as part of the international series at the Cape Town Convention Centre in October, attracting 222 international delegates. This was also the best-sponsored event, indicating the value that our generous industry partners see in our conferences
- ▶ The SAIMM's focus on the development of young professionals was highlighted in October 2015, with the

- hosting of the Student Colloquium and the Young Professionals Conference, both held at Mintek and attracting 243 and 82 attendees respectively. The Student Colloquium is the Institute's first exposure to the new class of mining and metallurgical professionals entering the industry the following year, who present their final-year projects. The Young Professionals Conference is aimed at the further development of young graduates who have recently entered the industry, focusing on their professional development and giving them an opportunity to present work they are engaged in
- ▶ The Mine Planning and Equipment Selection Conference, held at the Sandton Convention Centre, attracted 154 delegates to the four-day event, which focused on the use of technology in mine planning and best practice in the selection of underground and surface mining equipment
  - ▶ Strengthening the SAIMM's relationship with the Global Mine Standards Group (GMSG), a two-day conference was held at Emperors Palace in Kempton Park where local industry players were able to interact with other international GMSG members
  - ▶ The Diamonds Conference returned to Gaborone in March 2016 and exceeded attendance expectations, with 151 participants in the two-day international event

### Schedule of Mining/Metallurgy Technical Conferences, 2015/2016

Type of Event	Date	Title	Convenor	Attendance
Conference	6–8 July 2015	Copper Cobalt Africa In association with The 8th Southern African Base Metals Conferenc 2015	K. Sole	186
Conference	15–16 July 2015	VR Mining and Spatial Information Applications in the Mining Industry Conference 2015	J. Louw	74
Conference	5–7 August 2015	MINPROC 2015: Southern African Mineral Beneficiation and Metallurgy Conference	Western Cape Branch	142
Conference	19–20 August 2015	The Danie Krige Geostatistical Conference 2015	R. Minnitt	66
Conference	26–28 August 2015	MineSAFE 'Sustaining Zero Harm' Conference 2015	T. van den Berg	1137
Conference	28 September–2 October 2015	World Gold Conference 2015 Building a Resilient Gold Mining Industry	A. Swart	192
Symposium	12–14 October 2015	International Symposium on Slope Stability in Open Pit Mining and Civil Engineering 2015	R. Armstrong	222
Colloquium	20 October 2015	The Young Professionals Week 13th Annual Student Colloquium 2015	Z. Botha	243
Conference	21–22 October 2015	2nd Annual Young Professionals Conference 2015	A. La Grange	82
Conference	28–30 October 2015	AMI Nuclear Materials Development Network Conference	J. Nell	86
Symposium	8–13 November 2015	MPES 'Smart Innovation in Mining' 2015	C. Musingwini	154
Workshop	15–16 February 2016	Global Mining Standards and Guidelines Group 'Creating Community to Drive Operational Excellence'	D. Vogt	79
Conference	14–17 March 2016	Diamonds still Sparkling Conference 2016	H. Marsden	151
Conference	17–18 May 2016	The SAMREC/SAMVAL Companion Volume Conference 'An Industry Standard for Mining Professionals in South Africa'	K. Lomberg	133
Colloquium	9–10 June 2016	New Technology and Innovation in the Minerals Industry Colloquium 'Driving Mining and Metallurgical Productivity Improvement through Technology and Innovation'	A. Macfarlane	118
School	27–28 June 2016	The 2nd School on Manganese Ferroalloy Production	J. Steenkamp	74

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- Closing off the year's conferences was the New Technology and Innovation Conference. This is a new addition to our calendar and, following its success, is sure to be repeated in years to come. In particular, this event was the first to fully embrace social networking and to utilize virtual conferencing. This enabled presenters to partake from almost anywhere in the world.

The Mining TPC thanks all the Conference Committees for the hard work and dedication that they put into the organization of the past financial year's events, and the Secretariat for the endless hours and dedication behind the scenes in preparing for each of the conferences.

We look forward to the next financial year as an opportunity to continue to develop and expand the technical knowledge of the industry, and invite members of the Institute to contact the SAIMM office and volunteer to participate in the organization of conferences.

### 2.2 Technical Programme Committee—Metallurgy

Z. Botha, Chairperson

M. Dworzanowski, Vice-Chairman

R.T. Jones, Vice-Chairman

N. Blackham

A.F. Mulaba-Bafubiandi

T. Claassens

N. Naude

P. den Hoed

S. Ndlovu

E. Dhlamini

N. Segapela

I. Geldenhuys

H.A. Simonsen

K.J. Hay

A. Sithole

I. King

K.C. Sole

A. La Grange

J. Steenkamp

P. Muthaphuli

P.J. van Staden

J. Mishra

M. Valenta

M. Motuku

The Metallurgy Technical Programme Committee (TPC) supported a good selection of topical technical conferences for the continuing education of metallurgical professionals throughout the year. Among these topics were the very successful Copper Cobalt / 8th Base Metals 2015, World Gold 2015, Young Professionals 2015, AMI Nuclear Metals Development Network, Diamonds 2016, SAMCODE Companion Volume, New Technology & Innovation, and Manganese Ferroalloy School events. The Metallurgy TPC also supported New Technology in Mining, which for the first time included interactive information transfer via social media during the conference, as well as the Manganese Ferroalloy School. Some events were organized in conjunction with the Mining Technical Programme Committee.

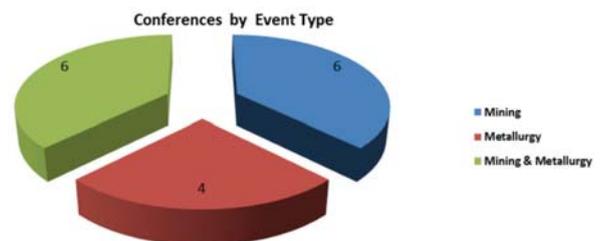
This year, the choice of subject matter for the conferences was more industry-driven, albeit still volunteer-driven. The Metallurgy TPC has focused more on innovation and changes in the mining and metallurgy industry, thereby supporting all SAIMM members during this changing and challenging time. The pioneering and inventive thinking of the TPC and all the conference convenors is highly appreciated. As always, all events provided an important forum for the efficient dissemination of information about new processes and techniques for improvement in the industry, as well as

promoting networking between industry professionals working in the metallurgical field. However, this year the TPC was much more focused on new processes, new techniques, and innovation in the industry. SAIMM conferences are generally accredited for continuing professional development (CPD) purposes as required by the Engineering Council of South Africa (ECSA).

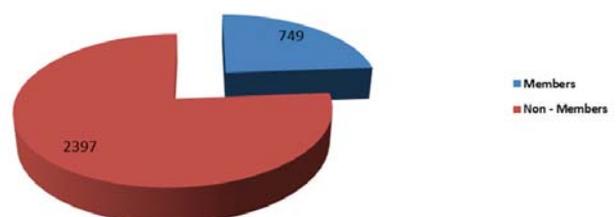
Formal proceedings of high-quality peer-reviewed papers continue to be published for most of the larger conferences; however, electronic copies are now provided to delegates as part of their registration package, and printed copies are produced on demand only. The SAIMM website is in the process of being updated, and conference proceedings are being published in full on the new site in order to make the information searchable and available to as wide an audience as possible. The SAIMM will continue to make their website publications available free of charge (via open access) to the general public, in recognition of the time and effort freely contributed by authors and the organizations where they work.

Attendance figures for this year's metallurgical technical conferences were on average 120, with a maximum of 192 delegates attending the World Gold 2015 conference. Sponsorship from July 2015 to June 2016 was R4 125 535, which is still at a significant level despite the rather poor state of the economy. The continued support of sponsors is highly appreciated.

Conference by event type	
Mining	6
Metallurgy	4
Mining & Metallurgy	6
	<b>16</b>

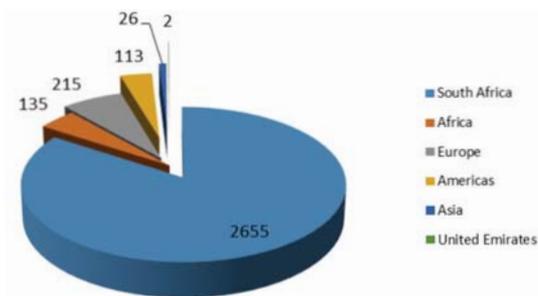


Attendee breakdown	
Members	749
Non-Members	2397
	<b>3146</b>



# Annual report

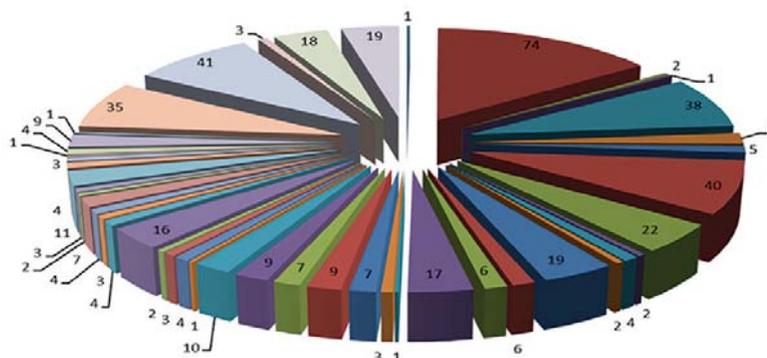
Attendance by continent	
South Africa	2655
Africa	135
Europe	215
Americas	113
Asia	26
United Emirates	2
	<b>3146</b>



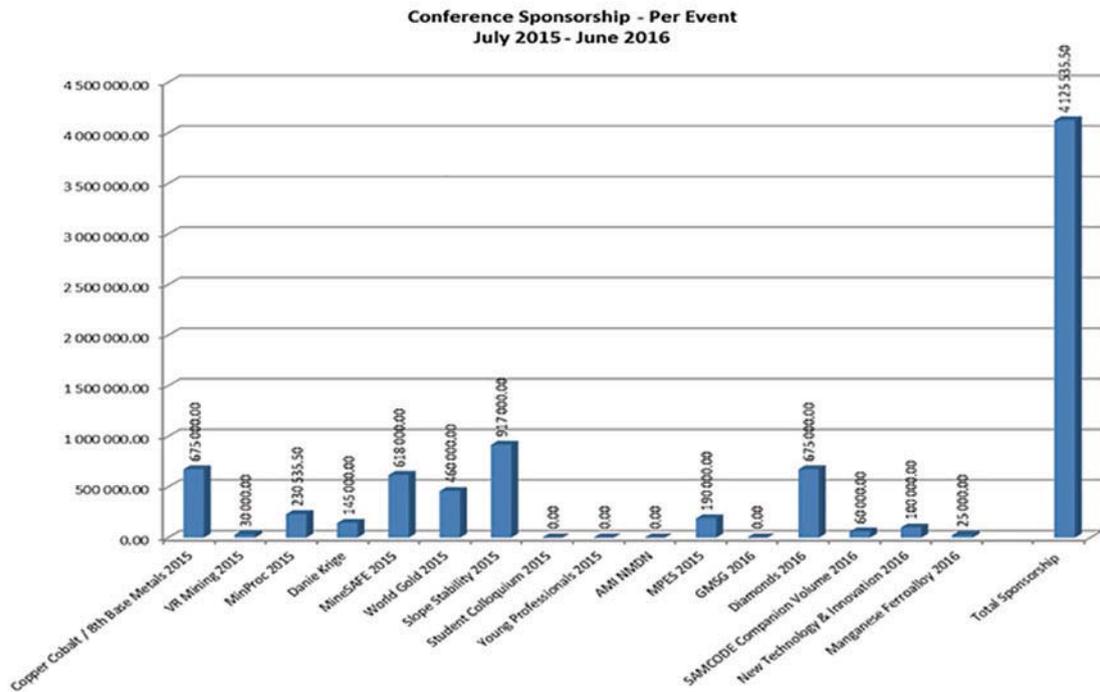
The Metallurgy TPC hosted the inaugural Copper Cobalt Africa Conference, which incorporated the 8th SAIMM Base Metals Conference. The conference was held in Livingstone, Zambia. Interest in the conference was strong; the 54 papers presented represented authors from six continents and fifteen countries. The conference was attended by some 180 delegates from nineteen countries, comprising researchers and academics, mining services professionals, vendors and technology suppliers, operations personnel, and consultants. Tremendous support was also received from sponsors, with demand for sponsorship and exhibition opportunities outstripping availability. The tone of the conference was set by the excellent keynote address by Jackson Sikamo, President of the Zambian Chamber of Mines, who provided an overview of the history of the Zambian mining industry from private ownership, through nationalization, and subsequent reprivatization, and included views on the challenges currently faced and suggestions as to how the industry can be nurtured to continue being a major driver for the Zambian economy and major player in the international copper mining business.

A significant step forward for SAIMM Metallurgy TPC supporting the New Technology in Mining (and metallurgy) Conference. There was a substantial initiative to integrate the

Delegates and Countries in attendance (excl. South Africa)					
Argentina	1	Ghana	1	Saudi Arabia	2
Australia	74	Indonesia	3	Scotland	3
Austria	2	Iran	7	Spain	11
Belgium	1	Italy	9	Sweden	4
Botswana	38	Japan	7	Switzerland	3
Brazil	8	Kazakhstan	9	Tanzania	1
Cameroon	5	Lesotho	10	The Netherlands	4
Canada	40	Madagascar	1	Turkey	9
Chile	22	Mali	4	Ukraine	1
China	2	Mauritius	3	United Kingdom	35
Czech Republic	4	Mexico	2	USA	41
Dominican Republic	2	Namibia	16	Vietnam	3
DRC	19	Nigeria	4	Zambia	18
Finland	6	Norway	3	Zimbabwe	19
France	6	Poland	4		
Germany	17	Russia	7		<b>491</b>



Conference days - per event			
Programme	Days	Programme	Days
Copper Cobalt / 8th Base Metals 2015	3	Young Professionals 2015	2
VR Mining 2015	2	AMI NMDN	3
MinProc 2015	2	MPES 2015	3
Danie Krige	2	GMSG 2016	1
MineSAFE 2015	3	Diamonds 2016	3
World Gold 2015	4	SAMCODE Companion Volume 2016	2
Slope Stability 2015	3	New Technology & Innovation 2016	2
Student Colloquium 2015	1	Manganese Ferroalloy 2016	2
		<b>Total Number of Conference Days</b>	<b>38</b>



technical event with social media and to promote real-time following of the conference on these platforms. The SAIMM Facebook page following increased by 87% and the campaign amounted to a total of 121 042 impressions on SAIMM’s page alone. Live videos, made available during the conference, proved to be the best method for driving engagement, with approximately 6 748 video views across all platforms.

Under the agreement negotiated with the Advanced Metals Initiative (AMI) in 2010, which is endorsed by the Department of Science and Technology, the AMI – Nuclear Metals Development Network 2015 Conference was hosted at the Nelson Mandela Metropolitan University in October 2015, with 86 delegates in attendance. The AMI collaboration is scheduled to continue until 2020, and a special edition of the *Journal* will be published for each event.

The Diamonds 2016 Conference, a two-day international event, returned to Gaborone in March 2016 and exceeded expectations for attendance with 151 participants. The focal

point for this conference was the challenges that this industry will face in the next few years. It was agreed that these challenges make for an exciting future; one that will require the kind of leadership, innovation, and belief in the ‘big picture’ that have sustained this industry for its first 150 years, to ensure that these challenges are overcome and that the diamond industry sparkles, shines, and lives up to its name for the next 150 years.

The SAMCODE Companion Volume Conference, hosted in collaboration with the Geological Society of South Africa (GSSA), was held at the Emperors Palace Convention Centre in May 2016 and attracted 133 delegates. The intention of the Companion Volume is to aid the Competent Person and Competent Mineral Asset Valuator when making Mineral Resource/Reserve and valuation declarations, and the objective of the conference and the Companion Volume is to provide a testimony of current industry benchmarks and best practices to be used or referenced when making a declaration.

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The annual Student Colloquium was again hosted by Mintek in Randburg. This event is subsidized by the SAIMM from the surplus funds from other events, in support of the various tertiary educational institutions in southern Africa. The Student Colloquium provides a showcase for students to present their final-year projects, and the winning presentations are subsequently published in the SAIMM *Journal*. General feedback this year was that the keynote speaker, Robin Banks, was 'mind-blowing', and that his address expanded what the audience had perceived to be possible in our current reality.

The second Manganese Ferroalloy School was hosted by the SAIMM in June 2016, and a total of 73 delegates attended compared with 83 at the first School in 2012. The event was attended by all four smelter operators – Transalloys, Mogale Alloys, Metalloys, and Assmang. A significant number of universities were represented (WITS, UP, UJ, NWU, VUT), with sponsorship by INFACON 2004 and Elkem Carbon Ferrovel. A post-school workshop was hosted and was very well supported, and a large number of research ideas were generated with the aim of supporting the drive to increase beneficiation of manganese ore in South Africa.

Cooperation continued with various international mining and metallurgical societies, including those based in the USA (SME, TMS, and AIST), Australia (AusIMM), Canada (CIM), and Europe (GDMB). We will continue to liaise closely with these international societies and plan on co-hosting a number of overseas international events, as well as cosponsoring events (which also entails publicizing the events to SAIMM members).

The Metallurgy TCP continues to be supported by a diverse group of highly capable members, who are all committed to innovation, knowledge transfer, and the dissemination of ground-breaking information. SAIMM's conferencing team is to be commended for a very successful year and their highly professional approach in handling conference arrangements, resulting in high-quality technical events and continued support from industry. The combined effort of all these people and the investment and support from industry has resulted, once again, in a successful year and excellent technical events being provided for the benefit of the metallurgical community of southern Africa.

### 2.3 South African National Committee on Tunnelling (SANCOT)

H.J. (Ron) Tluczek, Chairman

C. Viljoen, Vice Chairman

L. Nene, Chairman: Young Members Group

G.A. Davis

F.B. Stevens

P.H. Ferreira

D. Vogt

M. Lebitsa

J.W. Walls

J.L. Porter

M. Walnstein

D. Roos

J. van der Westhuizen

T.R. Stacey

The International Tunnelling and Underground Space Association (ITA) held its 42nd General Assembly together with the 2016 World Tunnel Congress (WTC) in San Francisco, USA from 22 to 28 April 2016. 2319 delegates participated in the conference. Chris Viljoen, Vice-Chairman of SANCOT, represented South Africa at the General Assembly on behalf of the SANCOT Committee.

South African representatives participate in four working groups. Ron Tluczek participates in WG 2 (Research), Chris Viljoen in WG 12 (Sprayed Concrete Use), and Monica Walnstein in WG 21 (Life Cycle Asset Management). Although Ron Tluczek (Chairman of SANCOT) was unable to participate in San Francisco, he was nevertheless voted in as Vice-Animateur for WG2.

Six reports were published in the previous year, three from ITA working groups and two from ITA tech activity groups, namely:

- ▶ WG2: Twenty Years of FCR Tunnel Segments Practice: Lessons Learnt and Proposed Design Principles
- ▶ WG11: Owners Guide to Immersed Tunnels
- ▶ WG14/19: Recommendations on the Development of Underground Projects with respect to Tunnelling Methods
- ▶ Guidance for Precast Fibre Reinforced Concrete Segments – Volume 1: Design Aspects
- ▶ Guideline for Good Practice of Fibre Reinforced Concrete Precast Segments
- ▶ Vibration Control in Urban Drill & Blast Tunnelling.

All these documents are available free of charge on the ITA website and available for comments.

The next annual meetings of the ITA General Assembly will be held at the following venues:

*Bergen, Norway:* from 9–16 June 2017, during the ITA-AITES WTC 2017 'Surface Problems – Underground Solutions'.

*Dubai, UAE:* from 20–26 April 2018, during the ITA-AITES WTC 2018 'Smart Cities: Managing the Use of Underground Space to Enhance Quality of Life'

*Naples, Italy:* from 2–9 May 2019, during the ITA-AITES WTC 2019 'Tunnels and Underground Cities: Engineering and Innovation meet Archaeology, Architecture and Art'.

### SANCOT News

One of the main focus areas for SANCOT is to promote interaction and closer communication between personnel and companies in the mining and civil industries, and to create a platform where expertise and experience gained in underground excavation can be shared.

In the civil engineering sector, due to the global increase in urbanization, pressure is being placed on governments and the public sector to provide expanded services such as safe and reliable public transport, electricity, gas, water, and sewage facilities. This results in further development of road, rail, and metro infrastructure. However, the availability of space for this necessary infrastructure in the urban environment is becoming a major challenge. In order to keep up with this increasing demand, civil designers and contractors are having to resort to tunnelling more than ever before, and in order to deliver these services timeously, mechanized underground excavation and support installation is proving to be cost-effective.

In the mining sector, the fast, efficient, and safe abstraction of raw mineral reserves is of strategic importance for leading mineral producers. However, rising labour costs, coupled with labour unrest, impact heavily on the ability of companies to achieve these goals. The South African mining sector needs to mechanize at a faster pace in order to remain globally competitive. This is particularly true when developing stopes and vertical shafts, since a typical deep-level mine has a life of 30 to 40 years, meaning that shafts are not sunk regularly and the specialized expertise may not be readily available.

## Annual report

With the prospect of several major tunnelling projects on the horizon, the active SANCOT membership is increasing. Two major projects which are imminent are:

- (a) The Lesotho Highlands Water Scheme, Phase II, which will incorporate the Polihali dam, the extension of the Muela hydroelectric complex, and the construction of 38 km of water transfer tunnel. This scheme will augment the water supply to the Gauteng area
- (b) The uMkhomazi Water Transfer Scheme, which will incorporate the Smithfield dam and 34 km of water transfer tunnel. This scheme will augment the water supply to the area under the jurisdiction of the Umgeni Water Board.

Four working groups are active within SANCOT:

WG 12: Sprayed Concrete Use

WG 14: Vertical Tunnelling

WG 21: Life Cycle Asset Management.

There is also a working group that is looking at hosting the ITA World Tunnelling Congress in South Africa in 2020. This is as a result of numerous enquiries that Ron Tluczek received at recent ITA World Tunnelling Congresses, and there would appear to be a lot of international support to hold a WTC in Africa, and specifically in South Africa.

### 3. Publications

Portfolio Holder: S. Ndlovu

D. Tudor, Chairman

R.D. Beck

J. Beukes

P. den Hoed

M. Dworzanowski

B. Genc

M.F. Handley

R.T. Jones

W.C. Joughin

J.A. Luckmann

C. Musingwini

H. Potgieter

T.R. Stacey

D. Vogt

#### 3.1 Journal

The Publications Committee acknowledges the tremendous contribution that Professor R.E. (Robbie) Robinson made to the fortunes of the *Journal* over many years. Sadly, Robbie passed away in January 2016. His obituary was published in the February 2016 edition of the *Journal*.

The breakdown of papers published during the year is as follows:

Year	Mining	Metallurgy	Other	Total
2014	43	41	13	97
2015	75	49	4	128
2016	59	76	2	137

Of the 137 papers published in 2015/16, 47 were from outside South Africa. The rejection rate of papers received was 26%.

The average monthly print run during the year was 3 000 copies.

Advertising revenue for the year totaled R1 561 219 which was some 7% below last year's figure.

In response to the call from Office Bearers to critically examine the Publications budget with a view to cost savings, a strategy session was held at the beginning of June 2016. An output from this exercise was a decision to implement the sending of an electronic copy of the *Journal* to every member, including student members. This required a substantial reduction of the file size that an electronic copy of the *Journal* took up to meet the distributor's target of 4MB per issue. The initiative commenced with the e-mailing of the April *Journal*, closely followed by the May *Journal*. The initial response from members has been positive and a survey will be conducted early in the new financial year to ascertain the level of satisfaction with the electronic copy of the *Journal* and to establish the number of members who no longer require a hard copy.

It is proposed to reduce the print run to 1500 copies during the next financial year, which will realize an estimated saving on printing and mailing costs of some R830 000 per annum.

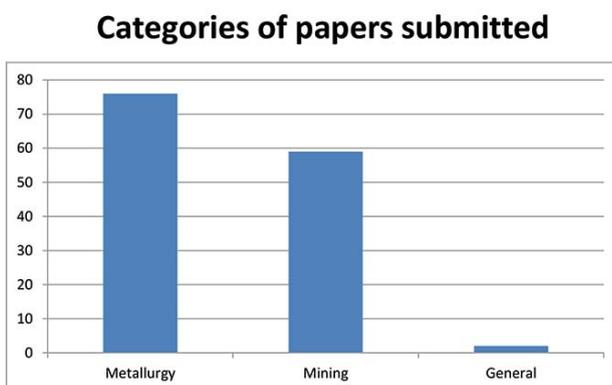
The Most Supportive Advertiser for the year is Elbroc Mining Products. The award will be given at the AGM

Investigations were conducted into plagiarism as well as editorial management software packages that the Publications Committee would like to have introduced to provide the publications team with tools to assist in streamlining the production of the *Journal*. Financial constraints have necessitated that this initiative be postponed to the next budget cycle.

We are indebted to our members who undertake the onerous task of refereeing papers. The meaningful feedback that the referees provide to the authors of papers has contributed enormously to maintaining the standard of the content of the *Journal*.

The publications team of Dawn van der Walt, Zulaikha Malgas, and Kelly Mathee has continued its good work in producing the *Journal*.

Metallurgy	76
Mining	59
General	2



Papers submitted by Country

Australia	2	Russia	2
Austria	1	South Africa	44
Azerbaijan	1	Slovakia	1
Botswana	1	South Korea	1
Chile	7	Spain	1
China	70	Sweden	3
Czech Republic	3	Switzerland	1
Egypt	1	Thailand	1
Germany	2	Turkey	14
Ghana	5	Ukraine	1
India	24	Usa	3
Iran	18	Zambia	5
Malaysia	3	Zimbabwe	4
Nigeria	2		<b>227</b>
Poland	6		

4. Regional Development

Key Performance Areas

To promote the interests of members based in different regions, the SAIMM:

- Supports the establishment and maintenance of branches to satisfy the local needs of its members for professional association and the exchange of technical information
- Co-operates with other member societies of AS&TS and with associations and interest groups that have close ties with operating mines and metallurgical plants by holding joint technical meetings and collaborating in the field of publication.

4.1 SAIMM Branches

4.1.1 Botswana

L.E. Dimbungu, Chairman

No report was available at the time of going to print.

4.1.2 DRC Branch

S. Maleba, Chairman

K. Banika            D. Sambwa  
F. Lubala            D. Tshibanda

The following activities took place during the year.

- A technical site visit to Tenke Fungurume Mining took place on 4 December 2015. The visit covered the entire project, from mining to copper cathode and cobalt salt production, and was attended by 23 professionals
- A professional development workshop, organized by ITASCA, from 6–7 of June 2016 at the Grand Karavia Hotel in Lubumbashi on the theme ‘Current Geomechanical and Hydrogeologic Trends in Open Pit Design, Analysis and Implementation’. DRC Branch members were invited to participate at a reduced rate
- CSI of South Africa and INPPAMET Anodos of Chile organized an electrowinning anode conference from 6–7

May 2016 at the Grand Karavia Hotel in Lubumbashi. The DRC Branch members of the SAIMM were invited to attend the workshop for free

- The Branch was invited to participate in the Mining Week Conference, held from 8–9 June 2016 at the Grand Karavia Hotel in Lubumbashi. Susa Maleba, the Branch Chairman and Roger Dixon of SRK Consulting were members of the panel on the Commodities focus session. The SAIMM was also represented on the panel of judges for the DRC Mining Industry Awards, which nominated the best mining companies’ performers for different categories. Roger Dixon gave a presentation on the recent trends in Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves.

4.1.3 Johannesburg Branch

I. Ashmole, Chairman

B.P. Abilliera            D. Jensen  
I. Ashmole                M. Mostert  
J. Clarke                 S. Nhleko  
G. Dellas                 D. Porter  
C. Heili                    J. Ruddy  
R. Heins                  G. Stripp  
H. Jantzen                M. Tlala

Introduction

The Johannesburg Branch’s main activity is to organize technical presentations on a monthly basis between February and November each year. These are generally held on the third Thursday of each month, and are traditionally followed by a cocktail party which gives attendees a chance to network with their peers. The costs of the venue hire and cocktail party have in the past been covered by sponsorships, either directly from the company presenting or from third parties with an interest in promoting their businesses to the audience.

In recent years as a result of the economic situation facing the mining industry, we have struggled to obtain sufficient sponsorship to fully cover the costs of these events, and thus since June 2014 we have held the presentations at the premises of Worley Parsons (who have kindly provided the venue at no

## Annual report

### Referees of papers submitted during 2016

Farzaan Abbasy	Willie Du Preez	Jean Malupo	Roelf Sandenbergh
Marat Abzalov	Marek Dworzanowski	Jannie Maree	Ewan Sellers
Catalina Alvarez	Markus Erwee	John Marriott	Glenn Sharrock
Neil Andersen	Essie Esterhuizen	Wynand Marx	Vusumuzi Sibanda
Ochieng Aoyi	Rosemary Falcon	Edward Mavhungu	Mark Silverwood
Robert Armstrong	Iain Farmer	Allan McCracken	Navin Singh
Winfred Assibey-Bonsu	Pete Ferreira	Norman McGeorge	Gordon Smith
Lidia Auret	Terrance Frangakis	Jeanette McGill	Janet Smith
Mark Austin	Peter Fraser	Bill McKechnie	Qurtus Snyman
Samson Bada	Murray Fredlund	Cor Meyer	Kathy Sole
Alex Bals	Bekir Genc	Bertie Meyer	Michael Solomon
Nicholas Barcza	Mugera Gitari	Graeme Miller	William Spiteri
Ian Barker	Olaf Goldbach	Doug Milne	Julie Stacey
Hugh Bartlett	Modreck Gomo	David Ming	Thomas Stacey
Hakan Basarir	Johan Gous	Dave Minney	Joalet Steenkamp
Carl Bergmann	Vasu Govindsammy	Richard Minnitt	Oskar Steffen
Marnus Bester	Dick Groot	Hani Mitri	Gerhard Stenzel
Johan Beukes	Alan Guest	Sofya Mitropolskaya	Jacobus Strauss
Marco Biffi	Daniel Guibal	Tshepo Mmola	Waldo Stumpf
Clinton Birch	Matthew Handley	Desmond Mossop	Ernst Swart
Steven Bluhm	Hu Hanrahan	Michael Moys	Marcelo Tavares
Tom Bookless	Kathleen Hansmann	Shaun Murphy	Peter Terbrugge
Gavin Brown	Harverson Robert	Cuthbert Musingwini	Andrew Thatcher
Jon Buckley	Kevin Hay	Alain Mwamba	Mpilo Thethwayo
Mark Burnett	Russell Heins	Oomeshni Naiker	Christine Thiar
Frank Calixto	Christian Holland	Alan Naismith	George Alex Thopil
Ismet Canbulat	Kevin Holley	John Napier	Tholana Tinashe
Frederick Cawood	John James	Andre Nel	Ron Tluczek
Kelello Chabedi	Willem Jordaan	Johan Nel	David Tudor
Vaughn Chamberlain	William Joughin	Michael Nicol	Hugo Tukker
Peter Chileshe	Robin Kear	Godknows Njowa	Sezer Uludag
Lesley Chown	Vladislav Kecojevic	Mark Noppe	Hakan Urcan
Johan Claassen	Danny Kentwell	Freeman Ntuli	Pieter Van Aswegen
Isobel Clark	Alan King	Seth Opoku	Bart Van de Steen
Andy Clay	Hendrik Kirsten	Julian Ortiz	Nielen Van der Merwe
Theresa Coetsee	Ekin Kis	Sam Palaniandy	Dirk Van Niekerk
Peter Cole	Peter Knottenbelt	John Parker	Petrus Van Staden
Nigel Coni	Dragan Komljenovic	Roger Paul	Pieter Gabriel Van Zyl
Luis Contreras	Geoff Krige	Richard Peattie	Julian Venter
Alan Cook	Jan Kuijpers	Arthur Pelton	Andrew Vietti
Herman Cornelissen	Jorg Lalk	Jochen Petersen	Fanus Viljoen
Lesley Cornish	Gys Landman	Pascale Petit	Jurgens Visser
John Cowan	Gary Lane	Lesley Petrik	Declan Vogt
Larry Cramer	Tony Leach	Huw Phillips	Kobus Vreugdenburg
Robert Cromarty	Paseka Leeuw	Rod Pickering	Nicola Wagner
Frank Crundwell	Oy Leuangthong	Matt Pierce	Diane Walker
Claude Cunningham	Daniel Limpitlaw	Pundy Pillay	Mark Wanless
Jane Danoczi	Philip Lloyd	Herman Potgieter	Ingrid Watson
Wolter De Graaf	Ken Lomborg	David Power	Dion Weatherley
Johan De Korte	Brian Loveday	Graham Priest	Nicholas Welham
Paul Den Hoed	John Luckmann	Chris Prins	Ivan Wermuth
Jared Deutsch	Ronald Machaka	Peter Radcliffe	Marcin Wertz
Roussos Dimitrakopoulos	Christopher Machio	Ganesh Rathod	John Whitall
Roger Dixon	Bernard Madden	Brad Rip	Rod Whyte
Christina Dohm	Aubrey Mainza	Dave Roberts	Mike Woodhall
Martin Dohm	Francois Malan	Dave Robinson	Mohsen Yahyaei
Andre Dougall	Ros Malloch	Marc Ruest	Lindiwe Zungu
Nicholas Du Preez	Dmitry Malovichko	Steven Rupprecht	Caliphs Zvinowanda

Johannesburg Branch of the SAIMM: technical presentations 2015/2016					
Date	Title	Presenter	Sponsor	Responsibility	Venue
16 July 2015	Update SAMREC / SAMVAL Codes	A. Kinghorn	Coffey Mining SA	I. Ashmole	Worely Parsons
20 August 2015	Student Debate: The New Neo-colonialism in Africa - Pros and Cons for the Mining Industry?	J. Luckmann and R. Heins	None	J. Luckmann and R. Heins	Worely Parsons
17 September 2015	Ivanhoe Mines first phase of the platreef project	G. Mouton	Ivanhoe	M. Walker	Worely Parsons
14 October 2015	Rock Hawg – the Tesmec way to surface mining	S. Fiorini	None	J. Luckmann	Worely Parsons
25 February 2016	New Gloria Ventilation Shaft: Success where Geoscience meets Engineering	N. Steenkamp	None	D. Munro	Worely Parsons
19 May 2016	Realizing the Productivity Potential of Joy Continuous Miners in Underground South African Coal Mines	D. Hoare	Joy Mining Global	G. Stripp	Worely Parsons

cost) at Melrose Arch. We have also taken measures to reduce the cost of the snacks in particular, and to reduce the drinks consumption by providing a limited number of vouchers to student attendees.

During the year under review, we struggled to secure high-quality presentations that were fully sponsored, and indeed we had several events where we were unable to raise any sponsorship above the venue provided by Worley Parsons. As a result, we held only six technical presentations (another was cancelled at the last minute as only three attendees had confirmed 24 hours prior to the presentation) for the year, down from the eight held in 2014/2015.

The student attendance at these events has been maintained, and we have also over the past year managed to get participation at one event from the University of Johannesburg's Metallurgy Department students, rounding out the attendance from UJ Mining and Wits Mining and Metallurgy students reported in previous years.

We kicked off the year in July 2015 with a presentation on the updated SAMREC/SAMVAL Codes by Ken Lomborg and Kelly Redman. This was followed in August by what has now become our annual student debate, with the topic 'The New Neo-colonialism in Africa – Good or Bad for the Mining Industry?' Once again, the debate was lively, and the students well prepared.

In September, Gerrick Mouton and his team from Ivanhoe Mining gave a very interesting presentation on their Platreef project. In October Simone Fiorini of Tesmec presented on their mechanized surface continuous miners and their applications in the mining industry. A planned event from Saveway Technologies on furnace protection was cancelled, as 24 hours before the presentation was due to take place, we had only received three RSVPs from attendees.

2016 began in February with a presentation by Dr Nicholaas Steenkamp on novel approaches to the ventilation shaft at Black Rock. We were unable to secure quality sponsored presentations for March and April, but returned in May with a presentation from Deane Hoare of Joy Global on efforts to enhance the productivity of continuous miners in the South African context. We were again, however, unable to secure a presentation for June.

In terms of finances, we ran at a deficit of R43 453 for the financial year, while in total 596 members attended the six events held.

Going forward, we have presentations secured for July and August (the student debate), as well as several other possible presentations in the pipeline – these will, however, be dictated by affordability in the current economic climate.

I would like to thank the Committee for their support and efforts over the past year, and Jacqui E'Silva for the secretarial and organizational duties.

### AGM

The Branch AGM was held on 23 June 2016.

### Committee

We welcome Nhleko Sihesenkosi as a new member of the Committee, while we say farewell to Russell Heins and George Dellas. We wish Russell and George well, and thank them for their hard work on the Committee. In addition, Ian Ashmole resigned as Chairman due to work commitments, but will remain as a member of the Committee. John Luckmann was elected as the new Chairman, having ably assisted as Vice-Chairman for the past two years, and we wish him well in his new role.

#### 4.1.4 Namibian Branch

N.M. Namate, Chairman

T. Iipinge	E. Shiningayamwe
T. Ipangelwa	B. Sililo
P. Kapitango	G. Ockhuizen
R. Shilongo	

Generally the year has been a success. Professionals in the industry are appreciating and becoming more aware of SAIMM activities and the benefits to individuals and the industry in general.

The organizational structure of the Branch has been reinvigorated to strategically position it for growth. Membership recruitment continues. The Branch expects to be able to participate in the activities of the Engineering Council of Namibia by end of 2016/2017.

The Namibian Branch participated at the Mine Expo in Windhoek towards the end of April, 2016.

Events planning continues, with one major international event on the cards and another local event to take place in mid-August 2016.

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### Membership

The Branch membership drive is continuing. Recruitment has been taken to all levels of management, with the result that more professionals are able to participate in Branch events. A case in point is the last technical event, hosted by the Namibian Uranium Association (NUA) in Swakopmund, which was well attended by representatives of various companies. This is in contrast to the earlier event where only one mine attended. It is possible that attendance might have been higher if the topics for presentation had covered mining as well (the main topic was uranium processing). The Branch Chairman visited a number of mines between February and May to promote the SAIMM as a viable professional organization that all professionals are encouraged to join. A number of student members (working in industry) were issued with forms to convert their Student membership to Associate membership, and a few members who had discontinued their subscriptions were encouraged to reactivate their membership. The new mining companies now in production (Swakop Uranium and B2 Gold) are a particular focus of the membership drive. The Chairman has successfully put forward the image that SAIMM membership is about realization of value through professional development. Membership is expected to continue to grow.

### Events

The Namibian Branch planned a number of technical events around the country.

1. On 20 November 2015 a technical presentation was planned at Tsumeb, which houses the copper smelter owned by Dundee Precious and is located in the vicinity of B2Gold's Oshikoto mine and Ohorongo Cement in Otavi. The objective was to bring together professionals, recruit new members, and introduce the plans of the Branch to members
2. On the 19 February 2016 an event was planned for Rosh Pinah in the south of Namibia, about 700 km from Windhoek. This town is located in the vicinity of three mines; the Rosh Pinah lead-zinc mine, Skorpion Zinc, and the Namdeb group of diamond mines. The main objectives were to bring together professionals, recruit new members, and also introduce Branch plans to members
3. On 11 March 2016 a presentation was planned for Windhoek, the capital city. The timing was intended to accommodate final-year students' project presentations for assessment with industry captains in attendance, to let the students showcase their capabilities and sell themselves to possible employers, and finally introduce the Young Professionals Council (YPC) to students and new entrants to the industry for support and guidance. Given the audience expected, this was also an opportune event for recruiting new members
4. On the 20th May 2016 an event was planned for the coastal town of Swakopmund, which is in the vicinity of all currently operating uranium mines, one lead mine, and a number of exploration projects. The objective was, as usual, to bring professionals together and recruit new members while introducing the Branch activities to members.

5. The Branch Annual General Meeting was planned for 24 June 2016, in Windhoek, with the aim of putting together all the year's efforts and programmes.

Unfortunately, out of the five planned events, only the technical event in Swakopmund did take place. The main presentation at the event was given by Dr Kathy Sole. The event was zero cost, but registration was mandatory. The venue (the NUA auditorium) for this event was filled to slightly beyond capacity. SAIMM staff (Sam Moolla and Jacqui E'Silva) attended the event and will bear testimony that a good cross-section of industry was in attendance. The event was co-sponsored by Namibia University of Science and Technology (NUST), the Namibian Uranium Association (NUA), and the Namibia Uranium Institute (NUI). The event provided an opportunity for networking and consultation among various attendees, and was a great success.

The Branch participated in the annual Mine Expo at the Windhoek Showgrounds from 27–28 April 2016, as part of the NUST contingent. The university has a complementary stand each year, where it showcases its programmes and activities. The SAIMM is hosted by NUST, and that collaboration is what makes the operations of the Namibia Branch logistically possible. However, since the stand is shared, activities were limited to membership promotion and explanation of the SAIMM's objectives and activities. A reasonable amount of interest was shown by visitors to the stand.

The rest of the planned events were either postponed to a later date (Rosh Pinah) or cancelled altogether in order to streamline resources and to make sure the objectives set are achieved.

The Branch is now looking at organizing an international event (a uranium conference) and is in the process of establishing its viability through consultations and assessments of needs. This is being done in conjunction with NUST and the Namibian Uranium Institute, as well as possibly overseas partner organizations.

### Challenges

A large part of the Branch membership seems to remember the SAIMM only when their subscription is due, or when the monthly e-mail publication arrives. This does not lend our membership experience the value that the organization has to offer. To counter this, the Branch has embarked on zero-cost interactions close to members' locations and dealing with issues right within their work confines. These proceedings are proving a good incentive, as there are a good number of professionals who would like to present their work at a wider forum than only inside their boardroom.

There is a vacuum within the engineering profession in general, and mining-related professions in particular, related to professional bodies and regulation. The Branch intends to support the existing professional organizations, and plans to join such organizations as the Engineering Council and the Geological Society in order to articulate the interests of members as well as offer advice on these bodies where necessary.

The administration of Branch affairs needs to be examined in order to ensure that some activities can be funded through subscriptions or some other means of support, to alleviate the personal cost burden on members.

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The student branch has taken a deliberate step to enhance value for young professionals by aligning itself with the activities and objectives of the SAIMM YPC. The contact person is a young female engineer who is working with Rio Tinto Rössing Uranium.

Finally, the new committee is strategically placed to take the Branch to higher levels, and we anticipate that it will be a great success.

### 4.1.5 Northern Cape

C. van Wyk, Chairman  
T. du Toit, Vice-Chairman  
B. Basson, Secretary  
I. Lute, Treasurer

A. April M. Luther  
J. Leader F. Nieuwenhuys

The Northern Cape Branch Committee was inaugurated on 7 October 2014. Two of the members resigned since they relocated nationally and internationally respectively, and two new members (Marius Luther and Fabian Nieuwenhuys) were elected. Charmelle Kearns is the latest member leaving the province. The Committee thanks her for the time and effort committed during her tenure.

The strategy for 2016 was influenced by the current economic climate in the province. Branch activities were scaled down considerably. A decision was made to focus mainly on the operations surviving the current commodity slump, and to hold only technical discussion sessions and recruitment sessions. Three sessions are planned in July 2016 and August 2016:

Venue	Date	Focus
Aggenuys	22 July 2016	Zinc, diamonds
Kathu	19 August 2016	Iron ore, manganese
Danielskuil	To be confirmed	Diamonds, lime

The AGM is planned for 19 August 2016 and will coincide with the recruitment session to take place in Kathu.

New members have joined the Institute this year. The Branch Secretary will assist with the control and management of new applications to keep track of potential new members and the current membership. A database of all professionals in the province had been developed and is being maintained. The database contains currently more than 60 individuals, who will be contacted on an individual basis.

Prices for bulk commodities decreased significantly in 2014/2015 to their lowest levels in recent times. Most of the Northern Cape mining companies are affected and are currently focused on mitigating the impact of the reduced prices. Securing company sponsorships of activities and events is challenging at present. Long distances between the different centres are also an obstacle to members gathering on a frequent basis.

Discussions were held with regard to strategic collaboration with the Northern Cape Mine Managers Association. Discussions around maintaining the SAIMM brand and identity took place. It was agreed that collaboration could have a positive influence on the sharing of technical knowledge in the Northern Cape.

### 4.1.6 Pretoria Branch

P. Bredell, Chairman

W.W. de Graaf N. Naude  
K. de Wet D. Powell  
R. Mabapa C. Siyasiya

The activities of the Branch continued with the format of previous years. An attempt was made to set up a video conferencing facility between the Pretoria and Johannesburg branches, but this was not successful. The idea was to enable the sharing of speakers between the two branches initially, but to set it up to be rolled out to other, more remote locations. The problems experienced are solvable and this will be attempted again in the coming year. Improved bandwidth for data transfer over the internet is required.

One seminar was organized in conjunction with the Department of Mining Engineering and the Department of Material Science and Metallurgical Engineering at the University of Pretoria's main campus.

On 13 June 2016 Professor Roger Reed, University of Oxford, gave a guest lecture on 'Some recent research on nickel-based superalloys for high-temperature systems'. The event was very well attended.

One of the core functions of the Pretoria Branch is to grow the SAIMM membership numbers through student membership. This was achieved this year through an event held on the Hatfield campus of the University of Pretoria, where all final-year students of Mining Engineering and Metallurgy were present to listen to Malcolm Walker. This was a very well-attended and successful meeting.

The Branch is currently in the process of drastically increasing the number of committee members in an attempt to plan for more events during the coming year. Already Kumba Resources has nominated a representative to serve on the Committee and more institutions located in the Pretoria area are being contacted. The Committee aims to host at least eight events over the coming year. The idea is to have the events coincide with the monthly social events of the Mining Alumni Society of the University of Pretoria (MASUP), to enable members to participate in the MASUP event after the technical talks. The events will be planned for the last Thursday of every month.

Finally, thanks to the Committee, the SAIMM Secretariat, and lastly a special word of thanks to Daleen Gudmanz and Gabi Ngema for playing a key role in making sure that all the events ran smoothly.

### 4.1.7 Western Cape Branch

A. Mainza, Chairman

L. Auret, Treasurer  
L. Bbosa T. Ojumu  
R.D. Beck J. Petersen  
J.A. Cruise C. Sweet  
D. Deglon J. Sweet  
A. Nesbitt

Academic personnel and students from the three main tertiary education institutions in the Western Cape (Cape Peninsula University of Technology, Stellenbosch University, and University of Cape Town) represent the majority of the members of the Western Cape Branch. The Branch events are therefore mainly aimed at providing students with information

## Annual report

about mineral processing career options and at creating a platform for students and academics to discuss their research. A number of retired members that have moved to Cape Town are also active in the Branch

The annual Southern African Mineral Beneficiation and Metallurgy Conference (Minproc) was held at the Vineyard Hotel in Claremont on 6 and 7 August 2015. Two plenary presentations were given at the conference. The first was delivered by Professor Magnus Evertsson from Chalmers University of Technology and focused on cone crusher modelling and simulation. Dr Rodney Jones presented on the theme 'DC arc furnaces - the story of a successful South African technology'. A total of 38 full oral presentations, 29 short poster presentations, and 13 posters without presentations were delivered over the course of two days. A total of 142 delegates attended the conference.

Several student prizes were awarded at the conference dinner, including the conference poster prizes which were won by Johannes Rabie (first prize) and Stefan Geldenhuys from the University of Cape Town (second prize). The Outotec Sustainability poster prize was won by Mpendulo Ncongwane from the University of Cape Town for a project entitled 'A feasibility study of the mineral carbonation of PGM tailings'. The second prize went to Bridgette Fundikwa for her project on the environmental assessment on the use of flotation for coal recovery and sulphur removal from fine coal. The President-elect of the SAIMM, Rodney Jones, presented SAIMM prizes to the best final-year students in Mineral Processing at the three main Western Cape tertiary education institutions in 2015. The recipients were James Brassell from Cape Peninsula University of Technology, Adriaan Henning from Stellenbosch University, and Daryl Brown from the University of Cape Town.

The conference dinner was preceded by the Branch AGM, at which the outgoing Chairperson, Christie Dolfing, presented his report and the new committee was elected. Aubrey Mainza was elected as Chairperson, Craig Sweet as Vice-Chairperson, and Lidia Auret as treasurer.

The conference was preceded by a one-day workshop that covered concentrator operations – crushing/screening, grinding, classification, and flotation/separation (including reagents, machines, and circuits). The workshop was practical; focusing on what technical people on site can do and should be doing to ensure that they get the most out of their plants in these lean times. The deliverable was a priority list of interventions and opportunity areas for each topic as a target value point. Magnus Evertsson (Chalmers University of Technology, Sweden), Elizma Ford (Mintek), Klaus Schommarz, (independent consultant), Mike Valenta (Metalicon), Martin Harris (University of Cape Town), and Ravesh Sogan (Hatch) presented material and Craig Sweet was the facilitator.

Given the Western Cape Branch's commitment to supporting student activities and through generous sponsorship from Outotec, the Outotec Travel Grant was awarded Brian Lindner in 2016.

The Branch finances are in good order. The Minproc Conference was not held in 2016 so as to allow the Hydromet conference to be managed by the secretariat with full involvement by the Branch. The Minproc Conference for 2017 will take place at the Vineyard Hotel in Claremont, and the dates will be decided at the AGM on 17 August 2016.

### 4.1.8 *Zambian Branch*

D. Muma, Chairman  
C.M. Walubita, Vice-Chairman  
A. Mhone, Secretary  
W. Munalula, Treasurer  
C. Ngulube            H. Zimba  
S. Sondashi

The recruitment of new members has continued, with specific focus on corporate membership. There was a remarkable increase in student membership in the last financial year. This could be attributed mainly to the engagement of the two largest Zambian public universities – the University of Zambia, Lusaka and the Copperbelt University, Kitwe – in the Branch's activities. The Branch is also considering extending collaboration with government departments and organizations such as the Chamber of Mines and the Mines and Safety Department under the Ministry of Mines and Mineral Development.

### *Activities*

A Branch technical event took place on 31 October 2014 at Chingola Protea Hotel; this was coupled with a technical site visit to Lubambe Copper Mines in Chililabombwe. The theme of the event was 'The role of engineers in the extractive industry'. Two technical papers were presented.

The first annual Zambian Mining Student Colloquium was held at the Copperbelt University in Kitwe on 11 June 2015, with the theme 'The future of the mining industry in Zambia and the roles of the SAIMM and the universities'. This was the first student colloquium hosted by SAIMM in Zambia and was attended by more than 140 students. Representatives of the Chambers of Mines of Zambia and the SAIMM Secretariat also attended.

The Copper-Cobalt Conference, in association with the 8th Southern African Base Metals Conference, took place from 6-8 July 2015 at Zambezi Sun Hotel, Victoria Falls. This conference, which was jointly hosted by the Mining and Metallurgy Technical Committees of the SAIMM, aimed to:

Zambian Branch Membership from 2011–2016						
Year	Members	Fellows	Associates	Students	Company Affiliates	Total
2015/2016	6	0	8	120	0	134
2014/2015	7	0	4	1	0	12
2013/2014	10	0	5	0	0	15
2012/2013	5	0	4	0	0	9
2011/2012	3	0	25	0	0	28

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- ▶ Promote dialogue between the mining and metallurgical disciplines on common challenges facing the industry
- ▶ Encourage participation and build capacity amongst young and emerging professionals from the Copperbelt region
- ▶ Improve understanding of new and existing technologies, leading to safe and optimal resource utilization.

The Zambian Branch was coopted to organize this great event, which attracted participants from all over the southern African region and beyond.

The Copperbelt Mining Trade Exposition & Conference (CBM-Tec) was held from 12–13 May 2016. The Branch presented a technical paper entitled 'Cost optimization strategies and technologies in the Zambian copper mines'. The event recorded the highest number of delegates, many of whom visited the SAIMM Zambian stand, and a good number of applications for membership were registered.

On 27 July 2016, Specialised Exhibitions Montgomery (SEM), in conjunction with Electra Mining of South Africa, entered into an agreement with the Branch to collaborate on the trade and mining exhibition in the Copperbelt region. SEM agreed to:

- ▶ Carry the SAIMM logo as an Endorsing Association on all collateral moving forward
- ▶ Include the SAIMM logo on the CBM Tec website
- ▶ Provide any collateral needed to market the show
- ▶ Provide a 9 m<sup>2</sup> outdoor stand (floor space only) to SAIMM at CBM-Tec free of charge.

The SAIMM will:

- ▶ Endorse CBM-Tec
- ▶ Assist in marketing CBM-Tec to its members in Zambia via functions, mailers, website etc.
- ▶ Include the CBM-Tec logo on the SAIMM website

### 4.1.9 Zimbabwean Branch

S. Ndiyamba, Chairman

#### Membership

The Zimbabwe Branch membership continues to grow through networking and awareness events targeted at engaging potential member's particularly tertiary institutions students. A number of meetings some of which were facilitated by the Regional Development Manager were held with various tertiary institutions. This has certainly increased awareness of SAIMM and its activities among the students.

#### Networking events

The Branch successfully organized networking and technical events and a Conference held in Bulawayo during the MINETRA exhibition. The conference theme was Innovation in Mining.

#### Branch Elections

A Branch Committee was elected during the year and the members are as follows:

S. Matutu	Chairman	Zimplats
M. Gumbie	Secretary/Vice Chairman	ZIMASCO
S. Sadomba	Immediate Past Chairman	ZMDC
O. Zvarevashe	Committee Member	Zimplats
M. Mariah	Committee Member	Virimayi Projects

C. Sadomba	Treasurer	ZIMASCO
C. Tahwa	Committee Member	Paasol Resources
E. Hove	Committee Member	Freda Rebecca
S. Gaihai	Past Chairman	ZMDC
W. Kutekwatekwa	Past Chairman	Wirimayi
S. Ndiyamba	Past Chairman	MIMOSA.

### 4.1.10 Zululand Branch

C. Mienie, Chairman

E. Clare	H. Pienaar
W. Jordaan	P. Strydom
R. Kutama	

Brett Cox resigned from the Committee. He was seconded within his company to an overseas operation.

Due to severe pressure from low product demand and commodity prices, most of the mines in the area are operating at 50% of normal capacity, and cost-cutting programmes are being implemented throughout the industry. Tata Steel SA, a ferrochrome smelting operation in Richards Bay, was liquidated during the latter half of 2015 after a failed business rescue attempt.

The Zululand Branch is working closely with the SAIMM office in Johannesburg with regards to the Heavy Minerals Conference (HMC 2016) which is being held from 16–18 August at Sun City.

Eriez / Macsalab (Pty) Ltd hosted a very enjoyable and well-presented technical meeting on laboratory and sample preparation equipment on 17 February. The event was attended by 18 people, the highest number in long time. This presentation is recommended to other SAIMM branches.

The following activities are planned for the year ahead:

- ▶ *Plant visit*—BHP Billiton Hillside (South32 aluminium smelter)
- ▶ *Social*—birdwatching event with family braai
- ▶ *Social*—end-of-year wine or whiskey tasting
- ▶ *Other*—financial / investments.

## 5. Engineering Council of South Africa (ECSA)

### Professional Advisory Committees

#### PAC Mining

M.H. Rogers, Chairman  
R.P. Mohring\*, Vice-Chairman

M.J. Motomogolo	V.P. Tobias
C. Musingwini	D.J. van Niekerk
J.C. Ngoma	S. Uludag
R.C.D. Phillis	R.C.W. Webber-Youngman
V.O. Seboni	L. Zindi
G.L. Smith	S. Zitha

\* Deceased

#### PAC Metallurgy

M. Dworzanowski, Chairman  
K.C. Mistry, Vice-Chairman

R.H. Eric	K. Poonan
I.J. Geldenhuys	R.F. Sandenbergh
R.T. Jones	M.D. Seke
S.M. Naik	M. Vermaak
J. Phiri	

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### *PAC Mining*

Rick Mohring, who served on a number of ECSA's committees and Council for many years and with great distinction, sadly passed away during the year. His sage guidance and advice will be missed.

The SAIMM has been associated with ECSA and its forerunner, the South African Council for Professional Engineers (SACPE), as a founding Voluntary Association since their inception. The SAIMM provides input into the ECSA committees by nominating members to serve on those committees.

The Committee continued to review and recommend applicants for registration as Professional Engineers. The SAIMM continued to arrange peer reviews of candidate professional mining engineers, which assistance is appreciated.

The impasse between ECSA and the Council for the Built Environment in respect of the 'Identification of Engineering Work' continues, with little progress having been made. No input was required from the Committee

The 'New Registration System' (NRS) for the online application for registration by Candidate Professional Engineers went live on 1 April 2016.

It is pleasing to note the increasing number of women applying for registration. It is expected that the number will continue to grow with increasing numbers graduating.

Five members of the current Committee with more than twelve years' service will no longer be eligible to serve after July 2016 and will resign. While it will be reasonably easy to appoint a more racially balanced Committee, this is not the case for women. The incoming Chairman and Committee will have to fill the vacancies with assistance from the SAIMM. It is noted that 57 per cent of the Committee are black or coloured, and 14 per cent are women. The emphasis for the incoming Committee will be gender equality.

### *PAC Metallurgy*

The mission of ECSA is to ensure, through a cooperative process of quality assurance, that persons entering the profession are educated and trained according to widely accepted standards, so as to be able to render a professional service for the benefit of the public and the country as a whole. The Professional Advisory Committees (PACs) of ECSA contribute to this mission by considering matters specific to the discipline and also contribute to wider policy matters as required.

During 2015/2016 the PAC Metallurgical Engineering again considered applicants for registration as Professional Engineers by means of paper evaluations and interviews, in which volunteers from the SAIMM participated. The requirement for Continuing Professional Development (CPD) of Professional Engineers for all registered persons opens up opportunities for the SAIMM to support the profession by the offering of seminars and conferences. This contributes to the CPD category 1, developmental activities. The SAIMM also supports the CPD process in category 3, individual activities, in which membership of the SAIMM, presenting papers at SAIMM conferences, and participating in SAIMM committees all contribute to CPD credits. The Committee wishes to record its thanks to the organizing committees and the Secretariat of the SAIMM for the issuing of CPD certificates.

During 2015/2016 no new members to the Committee were appointed. During 2016, ECSA introduced a new registration

system. All the committee members have received training in how the new system functions. The main difference with the new system is that it is structured around the assessment of the 11 competencies required of a Professional Engineer.

## 6. State Liaison

**Portfolio Holder: R.T. Jones**

### **6.1 Outcomes-based Education and Training (OBET)**

**Portfolio Holder: D.J. van Niekerk**

*Compulsory Registration with the Engineering Council of SA (ECSA)*

- The registration of persons currently performing Identified Engineering Work (IEW) is currently voluntary
- The promulgation and implementation of the proposed Identification of Engineering Work (IDoEW) Regulations will make registration with the Engineering Council of SA (ECSA) compulsory for Engineering Practitioners who perform IEW and take responsibility for such work
- The Competition Commission (CC), with the support of ECSA, has consulted all the interested and affected parties who submitted comments and who have raised concerns regarding the proposed IDoEW Regulations (CBE Board Notice)
- The CC has rejected the Council for the Built Environment (CBE) and ECSA's Exemption Application to publish the proposed IDoEW Regulations. The CC also rejected the exemption applications of all five of the other Professional Councils resorting under the CBE
- The CBE, in collaboration with the said six Professional Councils, is busy preparing appropriate appeals against the said ruling of the CC.

### *Engineering Candidature*

- ECSA is investigating an appropriate approach/model that will enable employers who train Candidate Engineering Practitioners under ECSA's Commitment and Undertaking (C&U) to claim some of the education and training expenditure from the relevant Education and Training Quality Assurer (ETQA)
- ECSA has established task teams to investigate and advise in respect of the preferred model for the funding of the Stage 2 training and experience of Candidate Engineering Practitioners.

### *New Registration System (NRS)*

- The NRS departs from the legacy registration system in that ECSA has decided to adopt an *Outcomes-based Education and Training (OBET)*-compliant competency standards and assessment model which is internationally benchmarked and recognized
- ECSA undertook a most successful NRS public consultation process during March 2015 in the main centres across South Africa. The outcomes will be published on the ECSA website in the form of appropriate frequently asked questions (FAQs)
- Applicants will continue to submit their applications to register with ECSA in paper-based format until the online NRS becomes operational. An appropriate phasing-out period of 12 months will be observed for paper-based applications.

### Focus for the SA Mining and Minerals Sector

#### IEW in the SA Mining and Minerals Sector (SAM&MS)

- ▶ Engineering Practitioners in the SAM&MS who perform IEW and take responsibility for such work will need to become registered in the appropriate category with ECSA
- ▶ The Engineering Practitioners in the SAM&MS who will be most affected by the proposed IDoEW Regulations include Engineers, Engineering Technologists, Certificated Engineers, and Engineering Technicians in the relevant engineering disciplines and/or vocational practitioners
- ▶ The level descriptors in the proposed IDoEW Regulations make an unambiguous distinction between the levels of engineering practice *vis-a-vis* 'complex' (Pr.Eng.), 'broadly-defined' (Pr.Eng.Tech. and Pr.Cert.Eng.), and 'well-defined' (Pr.Eng.Techn.)
- ▶ Numerous discussions held between the Mine Health and Safety Council (MHSC), the Mining Regulations Advisory Committee (MRAC)'s Task Team dealing with Mandatory Licensing in the SAM&MS, and ECSA, have led to a joint agreement to investigate the possibility of instituting some form of exemption for Competent Persons who perform and take responsibility for IEW
- ▶ ECSA has also consulted with PLATO, SACNASP/GSSA, and the SAIMM and its associated Recognized Voluntary Associations (VAs) in respect of overlaps between the Identified Work for the different professions/occupations in the SAM&MS. The agreed way forward in regard to the said overlaps that was proposed to the CC is the incorporation of an appropriate 'exemption clause' to the proposed IDoEW Regulations as well as the establishment of joint IDoW committees that will deal with specific overlaps between registration categories, persons registered with other statutory bodies, and relevant practice areas.

#### Cheadle, Thompson and Haysom (CTH) Report

- ▶ The Cheadle, Thompson and Haysom (CTH) Report dealing with certificates of competency (CoCs) in the SAM&MS was approved by a Stakeholder Consultative Workshop arranged by the Mining Qualifications Authority (MQA) held on 20 July 2012
  - The work relating to the implementation of the recommendations of the said Report was subsequently temporarily suspended until the completion of the Classification of Mines Project. To date the work relating to the said issue has not commenced
- ▶ The said CTH Report was referred for implementation to the Mining Regulations Advisory Committee (MRAC). To date the implementation of the recommendations of the said Report has not commenced.

#### Statutory Licensing in the SAM&MS

- ▶ The Department of Mineral Resources (DMR) undertook to expedite the implementation of the 'Report: Reverting back to the Blasting Certificate' which was approved by the Board of the MQA. To date, the work relating to this crucial issue has NOT recommenced
- ▶ The Inspectorate: Mineral Resources holds the

view/position that Certificates of Competency (CoCs) issued by the DMR are NOT qualifications and may therefore be withdrawn or suspended. Legal counsel considers the use of CoCs for the purposes of a Licence to Practice (LtP) as unconstitutional

- ▶ The DMR undertook to publish a draft list of occupations in the SAM&MS that would be subject to statutory licensing, (*the Big Five appointments*). The work relating to this crucial issue has not been completed.

#### Poor Examination Results : Government Certificates of Competency (GCCs)

- ▶ The draft, final 'Report: Poor Examination Results of Government Certificates of Competency (GCCs)' compiled by a University of Johannesburg (UJ) team, was approved at a Stakeholder Industry Workshop held on 22 August 2014
- ▶ The MQA Board approved the said Report and forwarded it for consideration and implementation to the MHSC. To date the work relating to this crucial issue has NOT commenced.

#### The 'New Model for CEs'

- ▶ An ECSA Standards Generation Group (SGG) developed a 'New Model for Certificated Engineers (CEs)' which proposes that the GCCs (seven in total) for Managers and Engineers in South Africa be replaced by registration with ECSA in the appropriate category of Pr. Cert. Eng.
- ▶ ECSA has agreed to establish a high-level Joint Steering Committee composed of representatives from the DMR, Department of Labour, Department of Transport, Department of Public Works, and ECSA to address the inappropriate duplication of requirements for CEs found in the different sets of legislation. Progress with this initiative is, regrettably, unsatisfactory.

#### Implementation of an OBET-compliant dispensation in the SAM&MS

The finalization/implementation of numerous Quality Council for Trades and Occupations (QCTO)-compliant qualifications for the SAM&MS has been derailed/delayed/suspended as a result of the re-introduction of the Blasting Certificate issued by the DMR.

### 7. International liaison

Portfolio Holder: R.T. Jones

#### Key Performance Areas

To achieve its objectives, the SAIMM

- ▶ Participates in and represents South Africa on bodies such as the Mining, Metals & Minerals Society (TMS), and together with Mintek on INFACON
- ▶ Appoints corresponding members in areas such as Australasia, Botswana, Brazil, Canada, Chile, Europe, the Far East, Ghana, New Zealand, the United Kingdom, and the United States of America, and interacts with sister institutions in other countries to promote international exchange of scientific and technical information.

## Annual report

### 7.1 INFACON

R.T. Jones, Chairman

I. Geldenhuys, Secretary General

The International Ferro-Alloys Congress (INFACON) was founded in South Africa in 1974 by the SAIMM, Mintek, and the Ferro-Alloys Producers' Association (FAPA) when the first INFACON was held in Johannesburg. The most recent Congress, INFACON XIV, was held in Kyiv, Ukraine in June 2015.

The International Committee on Ferro-Alloys (ICFA) was formed by the SAIMM, FAPA, and Mintek with the primary objectives being to promote the holding of the International Ferro-Alloys Congress every three years in appropriate locations, and to ensure that the high technical standard of papers and presentations is maintained. ICFA has representatives from the major ferro-alloy producing and consuming countries. Mintek provides the secretariat for ICFA.

INFACON has previously been held in the following countries and locations:

- 1974: INFACON I – Johannesburg, South Africa
- 1980: INFACON II – Lausanne, Switzerland
- 1983: INFACON III – Tokyo, Japan
- 1986: INFACON IV – Rio de Janeiro, Brazil
- 1989: INFACON V – New Orleans, USA
- 1992: INFACON VI – Cape Town, South Africa
- 1995: INFACON VII – Trondheim, Norway
- 1998: INFACON VIII – Beijing, China
- 2001: INFACON IX – Quebec City, Canada
- 2004: INFACON X – Cape Town, South Africa
- 2007: INFACON XI – New Delhi, India
- 2010: INFACON XII – Helsinki, Finland
- 2013: INFACON XIII – Almaty, Kazakhstan
- 2015: INFACON XIV – Kyiv, Ukraine.

The next congress, INFACON XV, will be held in South Africa in 2018, and will be co-chaired by Dr Rodney Jones and Professor Hurman Eric. The Organizing and Technical Committees are currently being convened. Companies wishing to sponsor the upcoming Congress should contact the organizers. The website for Infacon XV is <http://www.infacon15.com>

The SAIMM has an INFACON Fund that was established from the surplus generated by the last Congress that was held in South Africa, INFACON X. In the past year, this fund has supported a postgraduate bursary for one student doing pyrometallurgical research in ferro-alloys. Funds were also provided in support of the lecturing costs for two prominent overseas speakers at the SAIMM School on Manganese Ferro-alloy Production held in June 2016, and the attendance fees of a number of students were also sponsored by this fund.

Details will be made available on the INFACON website: <http://www.pyrometallurgy.co.za/Infacon/>

### 7.2 SAMREC/SAMVAL

T.R. Marshall, Chairperson

F. Cawood, Deputy Chair

A. Bals, SAGC

M. Booysen, Assoc. Law Society

A. Clay, SAMOG

K. Davies, SAICA

R. Dixon, SAIMM/CRIRSCO

S. Foya, Council for Geoscience

R. Ingram, Reader Panel

K. Lomborg, SAMREC/CRIRSCO

Adv. C. Loxton, Gen. Council for the Bar

S. Magnus, SAMESG

P. Rampersadh, SACNASP

K. Redman, SAMVAL

E. Swindell, GSSA

J. Visser, IMSSA

The SAMCODES Standards Committee (SSC) operates under the auspices of the Geological Society of South Africa (GSSA) and the Southern African Institute of Mining and Metallurgy (SAIMM). Its primary purpose is to develop, maintain, administer, ensure compliance with, and promote the South African Mineral Codes, collectively known as the SAMCODES, which is a collective acronym for the following documents:

- a. SAMREC: The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves
- b. SAMVAL: The South African Code for the Reporting of Mineral Asset Valuation
- c. SAMOG: The South African Code for the Reporting of Oil and Gas Resources
- d. Commodity- or subject-specific guidelines:
  - i. *SAMESG Guideline*: The South African Guideline for the Reporting of Environmental, Social and Governance Parameters within the Mining and Oil and Gas Industries
  - ii. *SAMREC Diamond Guidelines*: SAMREC Guideline Document for the Reporting of Diamond Exploration Results, Diamond Resources and Diamond Reserves (and other Gemstones, where Relevant).

In view of the fact that the SSC now deals with more than simply the SAMREC and SAMVAL Codes, a change of name was approved in August 2015 from the SAMREC/SAMVAL Committee to the SAMCODES Standards Committee.

As at November, 2015 the member organizations are:

- Law Society of South Africa
- Chamber of Mines of South Africa (COM)
- Council for Geoscience (CGS)
- South African Geomatics Council (SAGC)
- Institute of Mine Surveyors of Southern Africa (IMSSA)
- Department of Mineral Resources (including the Minerals Bureau) (DMR)
- Engineering Council of South Africa (ECSA)
- Geological Society of South Africa (GSSA)
- Geostatistical Association of South Africa (GASA)
- General Council of the Bar of South Africa
- Investment Analysts Society (IASSA)
- JSE Limited (including the Chairs of the relevant Readers Panels)
- South African Council for Natural Scientific Professions (SACNASP)
- Southern African Institute of Mining and Metallurgy (SAIMM)
- SA Institute of Chartered Accountants (SAICA).

## Annual report

In April 2016, letters were sent to each of these organizations requesting confirmation of membership and their respective representatives, to be ratified at the August meeting of the SSC. In view of the lack of oil and gas skills among the current members, it was unanimously decided that the South African Oil and Gas Agency (SAOGA) would be invited to become a member of the SSC, and they readily accepted.

The SSC continues to meet quarterly. Key issues and events influencing the business of the SSC during the period under review are as follows.

### SAMREC and SAMVAL

The first half of 2016 was a very busy time for both the SAMREC and SAMVAL Committees (in late 2015 it was agreed to change the names of the Working Groups to Committees). The SAMREC and SAMVAL Codes (2016 edition) were reviewed by the Financial Services Board and published in the Government Gazette, along with the new JSE Listing Rules. No comments were received back from this process, so the relevant Committees proceeded with the launch of the Codes. Although all Competent Persons (CPs) and Competent Valuators (CVs) are encouraged to use the 2016 versions of the Codes with immediate effect, they will be mandatory for JSE-listed companies (for CPRs and Annual Reports) only from 1 January 2017.

The Codes were implemented at the SAMREC/SAMVAL Companion Volume Conference held at Emperors Palace during May 2016, and subsequently launched at a function held at the JSE and celebrated by the blowing of the Kudu Horn.

- ▶ The 2016 versions of the SAMCODES were compiled into an A4 document comprising the SAMREC, SAMVAL, and SAMOG Codes. All Codes are available on the SAMCODES website (and have been sent to the SAIMM and GSSA for inclusion on their websites as well)
- ▶ In addition to the three Codes, two Guideline documents were also completed – the SAMESG and the Diamond Guidelines. The latter is simply part of the SAMREC Code, but can also be used as a stand-alone guide to the compilation of diamond-specific Competent Persons Reports (CPRs). Both documents have both been incorporated into the Companion Volume and also appear on the SAMCODES website
- ▶ The SAMREC/SAMVAL Companion Volume Conference was well attended, with about 130 people attending. Many of these were senior members of the industry and there was a good dynamic as a result. Some 61 papers were submitted and 32 were published. The general consensus from the delegates was that the papers and conference were of very high quality. The Conference Committee and the SSC would like to acknowledge the SAIMM conference team – particularly Sam Moolla, Raymond van der Berg, Camielah Jardine, and Nazli Mamdoo for their assistance in organizing the conference and the Companion Volume publication.

Minor administrative issues with the finalization of the Codes remain – mostly with updating the SAMCODES website postings and the organization of formal training programmes. Furthermore, the SAMVAL Committee will now concentrate on the fundamental issue of registration of CVs.

A short synopsis introducing the updated Codes (including a link to the SAMCODES website) has been compiled and sent to all of the member organizations of the SSC for inclusion on their websites.

### SAMOG

The SAMOG Code was tested within the context of the JSE Listing Requirements with the listing of an unconventional gas project. As a result of this listing, the SAMOG Committee and the Oil and Gas Readers Panel collaborated to identify potential modifications to the Listing Requirements and the Code. This was mainly because, in the international O&G community, the filing of a FORM 1 Report, as defined in the Code, was undertaken with the submission of comprehensive Qualified Reserves Evaluator (QRE) reports, which were not made available to the public but only to the regulator. The SAMOG Committee has, subsequently, identified items that needed to be lifted from the QRE report and included in the FORM 1 filing to eliminate the need for two reports. These are being deliberated upon with reference to an update of the Code.

### SAMESG

The 2015 SAMESG edition was officially launched on 19 May 2016, together with the 2016 editions of the SAMREC and SAMVAL Codes. The intention of the guideline is to assist reporting entities in providing adequate information on ESG matters that relate to their influence on the reasonable and realistic prospects for eventual economic extraction of the specific commodity being reported.

The SAMESG principles were presented at the 2015 CRIRSCO conference, through Ken Lomberg and Roger Dixon. It is understood that the principles have been accepted by the CRIRSCO Committee, and will be incorporated into the CRIRSCO template in the coming year. The SAMESG Committee has also initiated discussions with a number of individuals and institutions (including the JSE SRI Committee) regarding the broader application of the Environmental, Social and Governance parameters.

### Revision of SSC Terms of Reference

The SSC Terms of Reference document revision was initiated under Professor Fred Cawood in early 2015 and was finally completed in February 2016. It was implemented at the end of March 2016, after approval by the GSSA and SAIMM Councils. The main issues have all been addressed, including the finalization of the Complaints Procedure. The JSE Readers Panels' mandates are still outstanding, but good progress is being made toward completion.

### IDoEW Board Notice - CBE Notice on the Imminent Regulation of the Engineering Profession

Building on the work done by Professor Cawood in 2015, this issue had progressed significantly to the stage where it has been agreed that a Joint Working Committee (comprised of all of the interested and affected parties) should be established to address overlaps and develop appropriate legal text.

### CRIRSCO

The annual CRIRSCO meeting was held in November 2015 in Brasilia, Brazil. It was attended by Roger Dixon and Ken Lomberg. The salient points of the meeting were:

## Annual report

- Ken Lomborg had been appointed as Secretary
- Brazil joined CRIRSCO in November 2015 and Kazakhstan would be joining in mid-2016
- Detailed discussions were being held with India and the Peoples' Republic of China regarding their becoming members of CRIRSCO
- CRIRSCO would attend the UN Economic Commission for Europe (UNECE) meeting in Geneva in April, and the two organizations were holding regular discussions.
- A debate had been held on whether CRIRSCO should adopt or align with ISO Standards, and it had been decided not to go that route
- Marine mining had also been discussed at length with the Seabed Authority
- A working group had been formed to update the template for international reporting. The item on Exploration Results was a cause for concern as the JORC Code and the CIM Standards seemed to differ on the definitions
- The ICMM relationship was still good, but the budget had been reduced significantly, so CRIRSCO would be looking to the professional bodies and NRO's for financial support.

### IMVAL

Limited progress has been made within IMVAL during 2015/2016. The IMVAL template remains unchanged. Feedback has been received from some organizations (including SAMVAL and SAMOG) and this is being addressed. A scheduled meeting was postponed as some comments still needed to be added and addressed.

### Awards

On Tuesday 21 June, at the 31st Annual (Squirrel) Awards Ceremony of the Investment Analysts Society of South Africa held at the JSE in Sandton, the SAMREC/IASSA award for 2016 went to AngloGold Ashanti. This accolade is given for the Annual Integrated Report adjudicated best in terms of compliance with the JSE Listing Requirements and the SAMREC Code.

### 35th International Geological Congress

A number of papers are being prepared under the auspices of CRIRSCO by K. Lomborg and R. Dixon for presentation at the Congress.

In conclusion, I should like to thank the GSSA, SAIMM, and all of the members of the SAMCODES Standards Committee for their voluntary time and effort. There is so much that the SSC can contribute to the minerals industry and it is their support, hard work, and passion that make it all possible.

## 8. Management and Administration

### Portfolio Holder: M. Dworzanowski

The Secretariat consists of:

Miss Sam Moolla (Manager)

Mr Alf Bettoni (Accountant)

Miss Jacqui E'Silva (Head of Membership and Branch administrator)

Mrs Camielah Jardine (Conference Co-ordinator)

Miss Portia Malatji (Accounts Assistant)

Mrs Zuliakha Malgas (DTP Operator)

Miss Nazli Mamdoo (Conference Publications Co-ordinator)

Miss Kelly Matthee (Journal and Subscriptions Co-ordinator)

Miss Prudence Ntumeleng (Switchboard/Recept. & Asst. to Manager)

Mrs Anna Panana (Conference Assistant)

Mrs Apathia Sello (Administration Clerk)

Miss Keabetswe Shumba (Membership Application Processor)

Mr Raymond van der Berg (Head of Conferencing)

Mrs Dawn van der Walt (Head of Publications)

Miss Naomi Wernecke (Membership Application Processor)

The SAIMM, Office Bearers, and Council record their appreciation to the above for their service.

### 8.1 Finance

#### C. Musingwini

For the past few years we have been cautiously indicating that the finances in the years ahead would face different challenges to those of the past, and that the surpluses of former years invested with AFC would be under more pressure to assist in balancing our cash flow budgets.

The annual surpluses in the past dozen years have declined from a high of R5.9 million in 2011 to just R13.2 thousand in 2015, and this year to a deficit of R6.034 million, only the second time that a yearly deficit has been recorded since 2005.

We are all too aware that the environment in which we operate has not been the best on record. We can assure members that every effort was made to reduce and contain cost of sales and overheads. Our conference venue hire rates are constantly under review and other operating expenses are monitored with savings in mind. The reviews have been done without compromising the high professional standards synonymous with the SAIMM's pedigree.

Our bad debt write-off was R674 953, mainly in membership fees.

Indeed, in order to obtain a better picture of what the next few years might look like, budgets have been projected for the forthcoming and the following two year financial years, that is a three-year budget outlook.

Among the special projects this past financial year were:

➤ Scholarship Trust Fund donation	R220 000
➤ DTP Apple Mac upgrades	R125 372
➤ Global Mining Standards Group/CMMS	R52 517
➤ Infacon expenses	R19 452
➤ Membership Incentive Programme	R51 854
➤ Regional Development expenses	R457 093
➤ Technical library	R60 000
➤ Website development	R93 754
➤ Young Professionals Council	R26 685

Asset Values over the past 8 years were:

	R million
2008	17.9
2009	16.7
2010	20.3
2011	27.1
2012	26.7
2013	32.3
2014	38.9
2015	37.8
2016	32.8

Financial Statistics	Revenue	Cost of Sales	Operating Surplus/Deficit	Surplus/Deficit for year
2016	17 827 688	-18 104 388	-7 075 974	-6 034 222
2015	17 308 745	-13 263 913	-1 398 103	13 265
2014	17 102 755	-12 736 233	200 817	5 535 504
2013	18 236 500	-11 645 372	2 532 983	5 593 549
2012	15 791 264	-13 242 684	-2 094 409	46 709
2011	21 062 185	-13 723 262	2 515 452	5 900 497
2010	9 913 241	-8 234 553	89 725	2 564 365
2009	12 617 408	-12 104 395	513 013	-799 647
2008	5 063 861	-4 972 725	91 944	1 568 699
2007	3 348 192	-2 015 334	1 332 858	4 165 927
2006	3 303 914	-2 814 380	489 534	3 738 041
2005	2 063 715	-2 662 841	-599 126	1 352 537

## AFC Investment Fund

During the course of the year we have had to draw down from the AFC Investment Fund a total of R 5.750 million in order to support cash requirements.

The value of the fund at the beginning of the financial year was R34 457 678 (including the Western Cape Branch investment) and it closed at the end of June at R29 967 321, a decline of R4 490 357 which includes the draw-down mentioned above. It is forecast that a further draw-down of R2.5 million might be needed to tide us over this coming year. No further draw-downs are anticipated after this.

As outgoing Treasurer, I would like to sincerely thank the SAIMM Secretariat for their support.

## New Members

### Members

L. Adu-Nyamekye, B. Amisi Buuse, K.A. Annan, O.M. Barei, F.G. Beier, A.P. Boaduo, M. Bouhsane, R.J.R. Brito, A.M. Burger, E. Chanda, S. Chauraya, C. Chidziva, L. Chihota, S.B. Chinosengwa, F. Chiramba, K.A. Cooper, M. Dangeni, D.J.J. du Pisani, S. Fashu, P.D. Fick, W. Gabryk, L.Z. Gallant, M. Gautam, R.M. Genga, M.S. Gumbie, J.J. Helling, T. Hollenberg, I.Z. Jeremia, P. Kalota, G. Kapeso, J.N. Kayombo, B.J. Kloppers, I.A. Kola, D. Lipenege, M. Lombaard, L. Madziwa, F. Magweregwe, P.T. Makuvise, A. Mamuse, F.D. Manini, W.J. Mans, G.J.G. Marshall, L.M. Moagi, T. Moeti, B.L. Mona, T.O. Moore, L.K. Mpinare, N.C. Mpinga, E.S. Mtibilo, T.W. Mubvakure, M.N. Muguti, A. Mukuya, P. Munemo, C.F. Mutevhe, W. Mutsata, M. Muzima, M. Ncube, F.J. Ndaro, N.P. Nelwamondo, N.L. Nene, P. Ngwerume, K. Nkole, L. Ntombela, S. Nyamhandu, T. Nyirenda, A.M. Olivier, D.N.C. Phillpotts, R.W. Ruziwa, S.S. Schwartz, T.J. Sekoere, J. Sikamo, L. Silomba, S. Singh, A.J. Smit, P.A. Tanda, T.E. Tanyane, Z. Tembo, K.C. Teme, A. Tjock, V. Tsoyio, K. Tumagole, J.K. Vermaak, C. Whall, G.R.S. Wookey, Y. Zhang.

### Associates

S.J. Baumgartner, M. Bekker, D.I. Bennie, B. Bhila, T.S. Bvirakare, T. Chagwiza, K. Chisanga, M. De Freitas Silva, M. Hungwe, M.C.E. Jacobs, C.M. Kagarbi, F. Kaniki, P.T. Karembere, M.J. Kretzinger, A. Mabensela, A. Mabiza, H.D. Mabunda, D. Maikhudumu, T.A. Makhadimele, N.T. Makhalemele, E.T. Makopa, H. Maleka, L.L. Mankge,

K. Marira, M.G. Maruma, N.M. Mathebula, F.I. Matorofa, N.M. Matsokotere, M.E. Matsunyane, L.J. McEwan, A.A. Mkonde, P.V. Mokoena, E. Moonde, R.T. Muzambi, B.S. Mwashu, P. Naran, D.W. Nel, B.P. Nkosi, M.J. Nong, M.N. Pitja, S.L. Rabie, T.R. Radebe, M.C. Sehlola, M.M. Shoroma, Z.S. Sibanda, S.R.N. Staera, J.A. Strauss, C.M. Tamba, R. Tesa, J.S. Theron, I.C. Thobadi, T.T. Tiani, C. Tshuma, N. Uys, D.F. Verwey.

### Associates from Conferences

J.B. Agenbag, M.K. Alain, B.A.B. Alawad, D. Banerjee, J.L.V. Bazan, A.V. Bergh, G. Bhuvaneswaran, W.F. Boshoff, W. Bouwer, F.J.N. Bruwer, A.J. Carracedo Diez, T. Chagwiza, T. Chitindingu, B.S. Clapham, E.A. Clapham, D.C. Da Veiga, E. de Klerk, N.K. Didier, S. Dube, S.E. Ergün, N.M. Ernest, L. Fick, E.M. Ford, A.B. Gardiner, S. Garoeb, N. Gode, K. Hansmann, E.A.P. Hinojosa, S. Janse van Rensburg, M.K. Jules, T.G. Kakono, E.K. Kamuchele, L. Kawali, L.L. Kekana, A. Krassnokustki, M.G. Letlatsa, C. Lottering, M.R. Makgato, B. Manyike, J.O.H. Martin, L. Mokgalaka, B.T. Motlhagodi, P.M. Munsamba Lubaya, B. Muoneka, L. Murove, M.K. Muthathi, T. Mutongoreya, K. Mwaba, S. Naidoo, S. Nel, S.E. Ngubane, P.M. Nkulu, L.M. Omari, E. Özkan, P.J. Perold, S.P. Pillay, G. Priest, P.E. Ramashau, F.M. Ramsden, A. Rogers, M. Rohwer, H.Z. Schnetler, M. Seidu, I.A.D.M. Souza, K. Tlhagadi, T. Tshekiso, C.S. Ulansky, L.J. van Driel, A. Wolter.

### Students

S. Abass, I. Abdallah, J.A. Adams, E.A. Addae, S. Adjapong, G. Adjei, S.A. Adu Marfo, A.E. Adzigbli, S. Agyare, F. Agyemang, M.A. Al Mandalawi, E.I. Ali, M.P. Amini, I. Anafo, P. Antwi, H. Appiah-Twum, T.I. Armando, H. Ashraf, A.P. Atule, L.D. Ayedzi, C. Ayensu, N.E. Baloyi, T.D. Baloyi, A. Banda, G. Banda, H. Banda, L. Banda, P. Banda, V.K. Bashukwa, T. Batanidzo, D.A. Beke, M. Besa, H.S. Bezuidenhout, F. Bhachi, K. Bissere, M.S. Bkioni-Machawira, R.A. Blunden, E.A.N. Boadi, A. Boateng, A.B. Boateng, M.K. Bobbert, G.K. Bobo, L. Bokwe, D.L. Botha, M.N. Bow, A.B. Buabeng, T. Bvunzawabaya, T.M. Chakawa, P. Chanda, W. Chanda, B. Chandi, I.M. Changwe, N.T. Chapi, F.A. Charakupa, C.K. Charumbira, R. Chauke, E. Chaushi, C. Chemo, C. Chewe, Q. Chibesa, R.A. Chidedza, W.E. Chigadza, T. Chigava, K.C. Chigondo, C.A. Chiguware, V.A. Chigwendere, K.F. Chigweshe, T.C. Chihombori,

## Annual report

B.B. Chikasha, W. Chikola, M. Chikonkoto, S. Chikuni, K. Chikwanha, C. Chikwekwe, M. Chilekwa, J. Chilomo, L. Chilufya, R.F. Chimbunde, T.L. Chimeramombe, B. Chimuka, K. Chinaka, A.T. Chinhava, B.T. Chinheya, A. Chinyama, T.V. Chinyani, W. Chipangura, K. Chipembele, N. Chipomho, T.T. Chirara, K. Chiriga, C.T. Chirigo, I. Chirongoma, V. Chirozvani, T.M. Chisangowerota, T. Chisenga, C.M. Chisha, B.T. Chitapa, T. Chitengi, E. Chitiza, S. Chittigadu, S. Chiuyu, T. Chivanga, F.S. Chivende, T.B. Chivhima, T.E. Chivige, K.S. Chiwocha, K. Chiyimbi, N.C. Chokuda, N.L. Chola, T. Chombe, C.K. Chota, J.J.C. Christie, G. Chulu, R.E. Chuma, M. Dabishi, S.P. Dagbui, B. Daka, A. Dambudzo, N.D. Dandi, F.T. Danha, P.A. Darko, R. Das, D.E. De Beer, D. Deka, K.R. Dengure, V. Dhlumo, K.P. Dibodu, N. Dingani, P.A. Dinginya, H. Diop, N.S. Dlamini, W.J. Dobola, C. Dube, M. Dube, V. Dube, U. Dumela, T.I. Duri, J.H. Dusterwald, F. Dzapasi, B.T. Dzobo, J. Ferreira, P. Forson, V. Fosu, R.R. Friedland, T. Fusire, D. Gandawa, O.N. Garbah, J. Gardzielewicz, L. Gengezha, M.M. George, N.M. Gerema, F. Gombami, N.B. Gondo, K. Gorejena, R.M.N. Goremushandu, R.D. Govender, T.F. Gumbo, M. Gumbu, N.A. Gumpo, T. Gupta, L. Gurure, B.T. Gwenzi, B. Gyapong, G.A.F.S. Gyasi Agyem-Frempong, I. Hambombe, A. Hammond, F. Handireki, A.G. Harrison, T. Harrison, A. Hlati, B.B. Hlophe, N.F. Hobyani, T.H. Homera, A.I. Hove, N.V. Hove, T.T. Hove, N. Hughes, S.A. Isa, K. Issac, L. Jairos, A.R. Jarvis, T.D. Jawah, K.M. Jiho, C. Jirira, A.O. Junias, S.F. Jussa, E. Kabamba, D. Kabanga, F. Kabaso, S.T. Kabera, S. Kachusha, M. Kadango, B. Kafitwe, K. Kafwala, K.N. Kahondo, J. Kaluba, A. Kalusha, D. Kambangu, K. Kangwa, L. Kangwa, K. Kantonga, M.T. Kanyemba, O.N. Kanyiri, P. Kapembwa, B.T. Kapfumvuti, T.V. Kaponda, Y.S. Karikari, K.A. Kaseka, S. Kasekera, M.M. Kasoma, S. Katebe, P.K. Katele, M. Katongo, M. Katontoka, R.V. Katsande, N. Kennedy, K. Kevin, H. Khan, C. Khumalo, S.D. Kombe, E. Konadu-Yiadam, E. Koomson, E.T. Kore, W.R. Kudyanemba, D. Kunda, A.J. Kuubetersob, J. Kwiri, T. Lamani, M. Lambakasa, C.T. Lekesi, Y. Lilanda, T.L. Liswaniso, G. Lukwesa, M. Lukwesa, M. Lungu, S. Mabanja, T.S. Mabaya, I.D. Mabena, M.K. Mabika, S.S. Mabitla, N.D. Mabunda, O.S. MacGregor, J. Machona, T. Madade, R. Madamombe, L.P. Madera, T. Mafarachisi, W. Mafuriraraniwa, A.P. Mafuta, M.V. Magama, K. Maganga, L. Magombedze, P.C. Magorokosho, M. Magubane, A.N. Magumise, T. Magumise, T. Magure, L.N. Magwaza, R.M. Magwenzi, J. Mahembe, K. Mahlane, T.A. Mahlangu, V.V. Mahlangu, M.J. Mahlasela, N. Mahomed, M. Maimela, N. Maistry, A.J. Majaka, J.J. Majera, G.L. Makalela, N. Makhoba, N. Makoba, T.H. Makoena, N.R. Makoloane, P.J. Makono, T. Makopa, M.B. Makore, R.H. Makura, B. Makuza, L. Malama, M.M. Malatji, V. Manasoe, V.T. Mandabva, J. Mandaza, L.V. Mangena, T. Mangeya, P.P. Mangunda, A. Mangwanya, L. Mangwende, K.M. Mangwengwende, O.T. Manne, T. Manyanga, K.B. Manyenga, B. Mapako, L.T. Mapako, F. Mapasure, M.T. Mapheto, T. Maphinda, S.J. Maphosa, T. Mapooze, B. Maposa, B.T. Mapurisa, T. Marambi, C. Marashe, C. Maredi, O. Marekwa, L. Marongere, I. Marozva, M. Marulane, M.J. Maseko, J.C. Masetlwa, G.Z. Mashabane, S.M. Mashabela, P.R. Mashiri, S. Mashoko, S. Masilinge, N. Masimba, S.T. Masina, S.L. Masiyandima, P. Matanga, T.F. Mateko, B. Matewere, N.E. Mathebula, M.R.C. Mathipa, B.Z. Matika, D.T. Matika, M.P. Matlhwana, S. Matsika, T.A. Matumbura, T. Mavi, P. Mavurume, M.M. Mawere, N. Mawungwe, L. Mayovu, M.A. Mazai, N.A. Mazhunga, N. Mazodze, T. Mazonde, S. Mbatha, E.M.Y. Mbewe, W.R. Mbewe, M. A Mbongo, E. Mbwewe, D.L. McKay, O.N. Mekgoe, F.K. Mensah, M. Mensah, R. Mensah, S. Mensah, M. Mfula, N.P. Mguni, R. Mhaka, S.A. Mhangani, O.M. Mhasho, N. Mhere, T. Mhungu, M. Miselo, M.A. Mkaratigwa, E.G. Mkutchwa, N. Mlalazi, K. Mlauzi, O.O. Mlauzi, K.E.J. Mnguni, T. Modikwane, U. Moharsingh, M. Mokeba, M.M. Mokhoboana, K.C. Mokoena, S.S. Mokoena, J.M. Mokou, M.S. Molaba, T. Molefe, R.P. Molehe, M.E. Molote, M.C. Monteiro, C. Monze, T.E. Moongo, L. Morgan, K. Moro, T.S. Moropa, T.N. Moshabi, N. Motanyane, D.L. Motlakase, E.M. Mould, A.T. Moyo, B.S. Moyo, G.D. Moyo, S.M. Moyo, S. Mozah, P.J. Mpesi, C.M. Mphahlele, A. Mpofo, N.M. Mpofo, C. Mpoli, M. Mpundu, P. Mtero, F.C. Mthembu, K.C. Mthembu, K. Mubanga, I.T. Mubiana, C.M. Mubuzani, C.M. Muchinau, V. Mudau, J. Mudavanhu, C. Mudenda, P. Mudenda, R. Mudengezerwa, C.I. Mudimu, P. Muduzu, T.M. Mudyandzo, S.P. Mueza, K.R. Mugabe, R.T.K. Mugabe, Y.C. Mugandani, O. Mugangavari, D.M. Munganhu, E. Mugari, R. Mugezi, S. Mujakachi, T.R. Mujakachi, A.L. Mukatuni, M. Mukonyora, T. Mukupa, T.A. Mukwazhi, S. Mulauzi, L.C. Mulenga, M. Mulenga, R.C. Mulenga, T. Mulenga, M. Mulongo, C. Mumba, C.P. Mumba, S. Mumbela, L. Munarini, M. Munene, C.P. Mungwari, L. Munkhoyo, A.K. Munyanyi, R. Munyanyi, D.T. Mupanduki, P.S. Mupedzi, M.W. Mupfunya, L.T. Mupingo, T. Muqedani, M.S. Murakwani, N. Muranda, P.R. Muravugwa, A. Murevanhema, A.L. Murima, N. Murombo, T.G. Murwisi, V. Musengezi, L.T. Museza, D. Mushimbalume, E.C. Musikanyangwe, D. Musimbirachako, F. Musimeki, P. Musoko, D. Musonda, M. Musonda, K. Mutale, C. Mutale, M. Mutelo, B. Mutemererwa, J.B.F. Mutetwa, J.T. Mutungwazi, S. Muwongo, E. Muzamhindo, T. Muzangwa, K.T. Muzenda, B.T. Muzhingi, T.A. Muzidziwa, M. Mwaba, V. Mwaba, C. Mwachikorera, C. Mwale, H. Mwale, J.C. Mwangulu, E. Mwanja, C. Mwansa, A. Mwanza, A. Mwape, C. Mweemba, I.C. Mwrwa, T. Nachalwe, V. Nadasen, M. Namadandla, F. Namwila, J. Nanyangwe, A. Ncube, B.I. Ncube, B.M. Ncube, M.G. Ncube, M.J. Ncube, N. Ncube, C. Ndhlovu, L. Ndhlovu, G.S. Ndllovu, H. Ndllovu, I. Ndllovu, K. Ndilla, T.F. Nemandire, T. Nematadzira, N.L. Nene, G.V. Netshivhangoni, F. Ngambi, A.N. Ng'Andu, H. Ng'andu, T. Ng'Andwe, B.V. Ngirandi, T.J. Ngobeni, L. Ngono, B.P. Ngorima, A. Ng'uni, K. Ngweni, C. Ngwenya, O.P. Nhambe, A. Nhambura, A.T. Nhapi, C. Njekwa, M. Njili, L.A. Nkomo, M. Nkomo, M. Nkomo, J. Nkosi, S.G. Nkwanyana, B.M. Nocanda, L. Nsalala, B. Nsontaulwa, E.M. Nxumalo, L. Nyabezi, T. Nyagumbo, T.G. Nyambuya, C.R. Nyamupfukudza, F. Nyarugwe, G.T. Nyashanu, C.N. Nyathi, D. Nyathi, J.A. Nyathi, M. Nyathi, L.T. Nyatsanga, M. Nyoni, N.L. Nyoni, A. Nyumbu, N. Nzyenga, D.O. Okanigbe, N.M. Oppong, P. Osei, P. Otu, B. Owusu Boamah, N. Pasha, R.P. Passano, L. Pather, C. Pedzayi, M.P. Pelo, V.M. Penduka, P.L. Pete, P.L. Phetoe, B. Phiri, F. Phiri, M. Phiri, P. Phiri, S. Phiri, T.B. Phiri, P. Phiri Mkumba, J.S. Pienaar, S. Pieterse, V.K. Pillay, W. Potgieter, S.L. Pretorius, E.A. Quansah, T.R. Radebe, T.F. Ramathaga, M.D. Ramovha, T.M. Ramuhulu, B.S. Roche-Kelly, L.G. Rosaesoe, T.K. Rubaba, P. Ruduvo, S.N. Safo Kantanka, N. Saidi, I.T. Sakabuya, N. Sakalunda, B. Samatamba, T. Sandu, M. Satambo, T.E. Sebati, R. Sekgabi, T.R. Selota, T.A. Sethu, S. Shaikh, A. Shanzambwa, T. Shawa,

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L. Shayahama, K.M. Shayanowako, L.P. Shigwedha, J.M. Shikafwi, A.C. Shingange, L.K. Shixuanda, S.M. Sholande, C. Shumba, G. Shumba, O. Shumba, T.J. Shumba, A. Siamulonga, A.F. Siaw, A. Sibanda, N. Sibanda, P. Sibasa, S. Sibasa-Sibanda, A.M. Sichula, C. Sikazwe, F. Sikhosana, T. Simbanegavi, W. Simukoko, T. Simwambana, B. Sindane, A. Singh, G. Sinkamba, M. Sitali, E. Sithole, G.S. Sithole, V. Sithole, C. Siwale, M. Siwella, K.K. Sobiya, C.E. Sokotela, M.A.K. Suddoo, S. Surajew, W. Tafura, N.A. Tagara, W.E. Takawira, V. Takawira, L.C. Tamakloe, P. Tanganyika, T. Tarwirei, V.T. Tavaziah, T.C. Tavedza, M. Tembani, A. Tembo, C.J. Tembo, F. Tenkorang, A.V. Tezha, K.C.A. Thari, A. Tigere, M.J. Tjale, C. Truter, N.K. Tshabangu, T. Tsidzinye, D. Tugli, E.J. van der Merwe, C. Veremu, N.V. Wara, E.S. Wilson-Sowah, J.N. Yeboah, D. Zaba, M.G. Zholomi, B.K. Zhou, S. Zhou, L.N. Zietsman, C. Zimba, N. Zimba, T. Zimunya, A. Zindava, S.A. Zingoma, T. J Ziro, T.B. Zisunge, K. Zizhou, J.C. Zombe, K. Zondi, B. Zulu, O. Zvavanhu, S.T. Zvavashe, W. Zvingana.

### *Company Affiliates*

3M South Africa, Croniment Mining Processing SA (Pty) Ltd, Geobrug Southern Africa, Ivanhoe Mines SA, Kudumane Manganese Resources, Perkinelmer.

### *Resignations*

#### *Fellows*

P.K. Van der Heever.

#### *Members*

L. Andrews, M.J. Andrews, P. Dokie, R. Du Plessis, A. Du Toit, D.T. Foley, T. Gazis, C. Green, G.M. Greenway, N.A. Groenewald, G.C. Kraft, Q. Kruger, A. Lachman, J.M. Lloyd, J.A. Mackay, L. Matthysen, S. Mudaly, L.L. Muller, D.P.R. Munro, C.L. Reichardt, P.G. Van der Walt.

#### *Associates*

J. de Klerk, S. Gemmel, A.M. Harris, D.J. Jacobs, F. R. Koen, TE Kosana, J. Le Roux, T.A. Mokebe, P.R. Nieuwoudt, P.A. Schoeman, M.V. Surmon, J.R. Town.

### *Company Affiliates*

Deutsche Securities (Pty) Ltd, Ludowici Africa (Pty) Ltd, Osborn Engineered Products SA (Pty) Ltd, Scanmin Africa (Pty) Ltd, SNC Lavalin (Pty) Ltd.

### *Members transferred to Higher Grade*

#### *Transfer from Member to Fellow*

S.Y. Eshun, K.J. Richardson, S.S.J. Tose, L.J. Van Wyngaard, J. Venter.

#### *Transfer from Associate to Member*

C.P. Boonzaier, D.A. Christie, L.C. Coetzee, S.J.J. Grimbeek, A.A. Mhlongo, T.M. Mmola, P.N. Neingo, H.M. Nel, J.S. Ntsoelongoe, F.C. Passarelli, M.J. Robertson, L.K.O. Romano, S. Rusere, T. Tholana, P.B. Sagwette, M.M. Salamba, A.J. Scholtz, I. Serepa L. Seshibe, A. Shereni, H.B.M. Silva, M.A. Wailesi, O.W. Warschkuhl.

#### *Transfer from Member to Student*

A.R. Jarvis.

#### *Transfer from Student to Associate*

D. Kunda, K. Letsoalo, N.B.S. Magagula, F.J. Malatji,

G.T.M. Mohale, N.R. Molele, D.F. Muendane, N.Q. Ngwenya, M.S. Rasetlola, V.T.M. Tsotsotso.

### *Members who retired*

#### *Fellows*

C.E. Alvey, G.F. Bainbridge, E.J. De Jager, A.G. Du Plessis, F.M.G. Egerton, P.G. Gaylard, B.E. G. Johansson, C.G. Knobbs, G.H. Lawrie, I.A. MacFarlane, A.M. Marsh, B. Metcalfe, G.C. Oldroyd, J.N. Van der Merwe, J.A. Wells.

#### *Members*

P.D. Bates, P.W. Davey, R.E. Jennings, H. Mtegha, G. Nicholson, K.M. Steenkamp, I.R. Wermuth.

### *Deceased*

#### *Honorary Life Fellows*

R.P. Mohring, R.E. Robinson.

#### *Fellows*

A.S. Wood

#### *Retired Fellows*

R.C. Bertram, D.T. Fourie, D.L.J. Lawrence, B.H.L. Leach, B. Moore, D. Rankin.

#### *Retired Members*

T.E. Green

#### *Members*

J.D. Bethel, G.J.C. Strydom.

#### *Associate*

P. Charingira.

### *Members who were reinstated*

#### *Reinstated as a Member*

M.J. Andrews, P.N. Chavunduka, S. Chitambo, H.J. B. Combrink, L.I. Isaiah Marumole, R.B. Lechuti-Tlharerwa, G.C. Madzima, R.V.M. Mbhele, F.C. Ng'ona, H. Urcan.

#### *Reinstated as Associates*

E. Fouche, A.Y. Kipayko, C.B. Musimhi, C.F. Nkomba

### *Members who were re-admitted*

#### *Re-admitted as a Retired Member*

I. Corrans.

#### *Re-admitted as a Member*

M.A. Bantshi, D.J. Bradshaw, T.N.C. Chitah, Z.E. Cindi, R.D. Horne, B. Jirah, S. Kalombo, G. Kotze, F.N.F. Le Roux, P. Lugisani, E.C. Luyke, M.L. Mabotja, S.H. Mapheto, G. Marape, D.M. Marekwa, D.M. Mashile, K. Mutombo, I.O. Ogunniyi, T. Randima, O.V. Thobela, R.F. van Schalkwyk, C. Walubita, N.P. Zondi.

#### *Re-admitted as a Associate*

T.D. Lekoko.

#### *Re-admitted as a Student*

N. Baloyi, A.D. Biya, M.E. Khonothi, K.M. Khosana, E.L.J. Kleynhans, M.D. Kyembo, M.P. Mametja, S.R.A. Mashimbye, N.T. Mkhawana, Z.F. Mulaudzi, P.L. Ngwenyama, R.I. Sekabate, B.M. Thethwayo, L. Zombene. ♦

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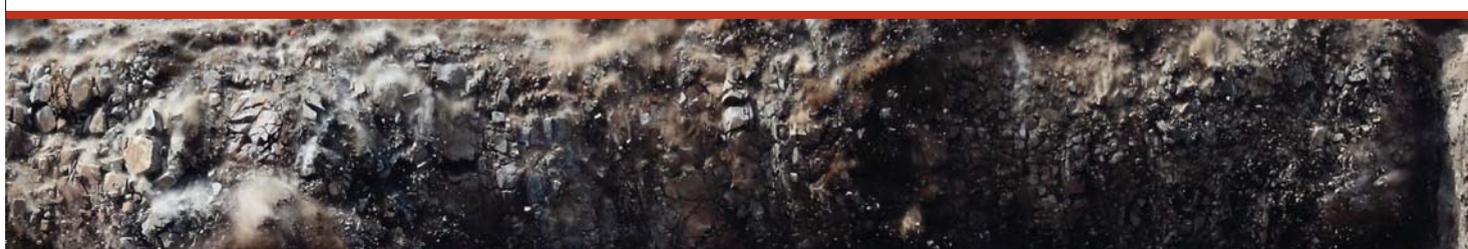
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## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

**Annual Financial Statements**  
*for the year ended 30 June 2016*

#### Statement of Council members' responsibilities and approval

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The Council members are required to maintain adequate accounting records and are responsible for the content and integrity of the annual financial statements and related financial information included in this report. It is their responsibility to ensure that the annual financial statements fairly present the state of affairs of the Institute as at the end of the financial year and the results of its operations and cash flows for the period then ended, in conformity with the accounting policies appropriate to the Institute. The external auditor is engaged to express an independent opinion on the annual financial statements.

The annual financial statements are prepared in accordance with the accounting policies appropriate to the Institute and are based upon appropriate accounting policies consistently applied and supported by reasonable and prudent judgements and estimates.

The Council members acknowledge that they are ultimately responsible for the system of internal financial control established by the Institute and place considerable importance on maintaining a strong control environment. To enable the Council members to meet these responsibilities, the Council set standards for internal control aimed at reducing the risk of error or loss in a cost-effective manner. The standards include the proper delegation of responsibilities within a clearly defined framework, effective accounting procedures, and adequate segregation of duties to ensure an acceptable level of risk. These controls are monitored throughout the Institute and all employees are required to maintain the highest ethical standards in ensuring the Institute's business is conducted in a manner that in all reasonable circumstances is above reproach. The focus of risk management in the Institute is on identifying, assessing, managing, and monitoring all known forms of risk across the Institute. While operating risk cannot be fully eliminated, the Institute endeavours to minimize it by ensuring that appropriate infrastructure, controls, systems, and ethical behaviour are applied and managed within predetermined procedures and constraints.

The Council members are of the opinion, based on the information and explanations given by management, that the system of internal control provides reasonable assurance that the financial records may be relied on for the preparation of the annual financial statements. However, any system of internal financial control can provide only reasonable, and not absolute, assurance against material misstatement or loss.

The external auditor is responsible for independently reviewing and reporting on the Institute's annual financial statements. The annual financial statements have been examined by the Institute's external auditor and his report is presented on page 866.

The annual financial statements set out on pages 867 to 879, which have been prepared on the going concern basis, were approved by the members and are signed on their behalf by:

Signed by: R.T. Jones

\_\_\_\_\_  
President

2 August 2016

\_\_\_\_\_  
Date:

Signed by: C. Musingwini

\_\_\_\_\_  
Treasurer

2 August 2016

\_\_\_\_\_  
Date:

### Report of the independent auditor

#### To the members of The Southern African Institute of Mining and Metallurgy

I have audited the annual financial statements of The Southern African Institute of Mining and Metallurgy, which comprise the statement of financial position as at 30 June 2016, the statement of comprehensive income, statement of changes in reserves, and statement of cash flow for the year then ended, and a summary of significant accounting policies and other explanatory notes, as set out on pages 867 to 877.

#### Council Members' responsibility for the Annual Financial Statements

The Institute's Council members are responsible for the preparation and fair presentation of these annual financial statements in accordance with the accounting policies appropriate to the Institute and for such internal control as the Council members determine is necessary to enable the preparation of annual financial statements that are free from material misstatement, whether due to fraud or error.

#### Auditor's responsibility

My responsibility is to express an opinion on these annual financial statements based on my audit. I conducted my audit in accordance with International Standards on Auditing. These standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance whether the annual financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the annual financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risk of material misstatement of the annual financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Institute's preparation and fair presentation of the annual financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Institute's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the annual financial statements.

I believe that the audit evidence obtained is sufficient and appropriate to provide a basis for my audit opinion.

#### Opinion

In my opinion, the annual financial statements present fairly, in all material respects, the financial position of The Southern African Institute of Mining and Metallurgy as at 30 June 2016, and its financial performance and its cash flows for the year then ended in accordance with the accounting policies appropriate to the Institute.

#### Supplementary information

Without qualifying my opinion, I draw attention to the fact that supplementary information set out on pages 878 to 879 does not form part of the annual financial statements and is presented as additional information. I have not audited this information and accordingly do not express an opinion thereon.

**AUDITOR: R.H. Kitching**  
*Chartered Accountant (S.A.)*  
*Registered Accountant and Auditor*

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Statement of Financial Position

for the year ended 30 June 2016

	Note	2016 R	2015 R
<b>Assets</b>			
<b>Non-current assets</b>			
Property, plant and equipment	2	262 142	189 214
Loan to associate entity	3	206 468	-
Other financial assets	4	27 458 066	32 155 290
		<b>27 926 676</b>	<b>32 344 504</b>
<b>Current assets</b>			
Inventories	5	210 487	210 487
Trade and other receivables	6	403 426	1 532 391
Cash and cash equivalents	7	4 270 976	3 699 1253
		<b>4 884 889</b>	<b>5 442 003</b>
<b>Total assets</b>		<b>32 811 565</b>	<b>37 786 507</b>
<b>Reserves and Liabilities</b>			
<b>Reserves</b>			
Reserves	8	5 223 902	4 998 949
Retained income		26 040 693	32 074 915
		<b>31 264 595</b>	<b>37 073 864</b>
<b>Liabilities</b>			
<b>Non-current liabilities</b>			
Loan from associate entity	3		215 209
<b>Current liabilities</b>			
Trade and other payables		1 230 419	202 967
Deferred income		-	51 365
Provisions		316 551	243 102
		<b>1 546 970</b>	<b>497 434</b>
<b>Total liabilities</b>		<b>1 546 970</b>	<b>712 643</b>
<b>Total Reserves and Liabilities</b>		<b>32 811 565</b>	<b>37 786 507</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Statement of Comprehensive Income

for the year ended 30 June 2016

	Note	2016 R	2015 R
Revenue		17 827 688	17 288 491
Cost of sales		(18 104 388)	(13 263 913)
<b>Gross profit</b>		<b>(276 700)</b>	<b>4 024 578</b>
Other income		961 273	1 592 400
Operating expenses		(7 760 547)	(7 015 081)
<b>Operating surplus</b>	9	<b>(7 075 974)</b>	<b>(1 398 103)</b>
Investment revenue		1 098 584	918 701
Royalties OneMine		80 418	54 093
Fair value adjustments		(25 631)	498 945
Finance costs		(111 619)	(60 371)
<b>Surplus for the year</b>		<b>(6 034 222)</b>	<b>13 265</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Statement of Changes in Reserves

for the year ended 30 June 2016

	Funds	Retained incomes R	Total reserves R
<b>Balance at 1 July 2014</b>	<b>4 783 683</b>	<b>32 061 650</b>	<b>36 845 333</b>
Changes in reserves			
Surplus for the year	-	13 265	13 265
Transfer of interest	215 266	-	215 266
Total changes	215 266	13 265	228 531
<b>Balance at 1 July 2015</b>	<b>4 998 949</b>	<b>32 074 915</b>	<b>37 073 864</b>
Changes in reserves			
Surplus for the year	-	(6 034 222)	(6 034 222)
Transfer of interest	224 953	-	224 953
Total changes	224 953	(6 034 222)	(5 809 269)
<b>Balance at 30 June 2016</b>	<b>5 223 902</b>	<b>26 040 693</b>	<b>31 264 595</b>

Note(s)

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## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Statement of Cash Flows

for the year ended 30 June 2016

	Note	2016 R	2015 R
<b>Cash flows from operating activities</b>			
Cash generated from (used in) operations	11	(4 991 464)	(3 534 904)
Interest income		208 003	136 914
Dividends received		890 581	781 787
Finance costs		(111 619)	(60 371)
<b>Net cash from operating activities</b>		<b>(4 004 499)</b>	<b>(2 676 574)</b>
<b>Cash flows from investing activities</b>			
Purchase of property, plant and equipment	2	(131 032)	(75 251)
Loans received/(advanced) to associate entity		(421 677)	225 000
Purchase of investments		-	(1 125 729)
Net sale of investments		4 904 106	-
<b>Net cash from investing activities</b>		<b>4 351 397</b>	<b>(975 980)</b>
<b>Cash flows from financing activities</b>			
Interest allocated to fund investments		224 953	215 266
<b>Total cash movement for the year</b>		<b>571 851</b>	<b>(3 437 288)</b>
Cash at the beginning of the year		3 699 125	7 136 413
<b>Total cash at end of the year</b>	7	<b>4 270 976</b>	<b>3 699 125</b>

# Annual Financial Statements

## The Southern African Institute of Mining and Metallurgy

### Notes to the annual financial statements for the year ended 30 June 2016

#### Accounting policies

##### 1. Presentation of annual financial statements

The annual financial statements have been prepared in accordance with accounting policies appropriate to the Institute. The annual financial statements have been prepared on the historical cost basis, except for the measurement of certain financial instruments at fair value, and incorporate the principal accounting policies set out below. They are presented in South African rands.

These accounting policies are consistent with the previous year.

##### 1.1 Significant judgements and sources of estimation uncertainty

In preparing the annual financial statements, management is required to make estimates and assumptions that affect the amounts represented in the annual financial statements and related disclosures. Use of available information and the application of judgement is inherent in the formation of estimates. Actual results in the future could differ from these estimates which may be material to the annual financial statements. Significant judgements include:

###### Provisions

Provisions were raised and management determined an estimate based on the information available.

###### Inventories

The inventories of publications are held and sold by the Institute for its own account and on behalf of its publishing partners who have underwritten some of the publications. The inventories are reflected in the financial statements at nominal value. The inventories of authors' gifts and stock held from conferences are carried at cost. Provision is made for impairment.

##### 1.2 Property, plant and equipment

The cost of an item of property, plant, and equipment is recognized as an asset when:

- It is probable that future economic benefits associated with the item will flow to the Institute; and
- The cost of the item can be measured reliably.

Maintenance and repairs which neither materially add to the value of assets nor appreciably prolong their useful lives are charged against income.

Property, plant, and equipment are carried at cost less accumulated depreciation and any impairment losses.

Depreciation is provided using the straight-line method to write off the depreciable amount of items, other than land, over their estimated useful lives, using a method that reflects the pattern in which the assets' future economic benefits are expected to be consumed by the Institute. Depreciation is provided on leasehold improvements over the remaining period of the lease.

Gains and losses on disposals are determined by comparing the proceeds with the carrying amount and are recognized in surplus or deficit in the period.

The depreciation charge for each period is recognized in surplus or deficit. Medals, plaques, dies and banners are recorded at nominal values.

# Annual Financial Statements

## The Southern African Institute of Mining and Metallurgy

### Notes to the annual financial statements for the year ended 30 June 2016

#### Accounting policies

##### 1.3 Impairment of assets

The Institute assesses at each reporting period date whether there is any indication that an asset may be impaired. If any such indication exists, the Institute estimates the recoverable amount of the asset.

If the recoverable amount of an asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. That reduction is an impairment loss.

An impairment loss of assets carried at cost less any accumulated depreciation or amortization is recognized immediately in surplus or deficit. Any impairment loss of a revalued asset is treated as a revaluation decrease.

##### 1.4 Financial instruments

###### Initial recognition

The Institute classifies financial instruments, or their component parts, on initial recognition as a financial asset, a financial liability, or an equity instrument in accordance with the substance of the contractual arrangement.

Financial assets and financial liabilities are recognized on the Institute's balance sheet when the Institute becomes party to the contractual provisions of the instrument.

Financial assets and liabilities are recognized initially at cost; any transaction costs that are directly attributable to the acquisition or issue of the financial instrument are added to the cost.

###### Subsequent measurement

After initial measurement, financial assets are measured as follows:

- Loans and receivables and held-to-maturity investments are measured at amortized cost less any impairment losses recognized to reflect irrecoverable amounts.

After initial recognition, financial instruments at fair value through surplus or deficit are subsequently measured at fair value, with gains and losses arising from changes in fair value being included in surplus or deficit for the period.

After initial recognition, financial liabilities are measured as follows:

- Financial liabilities at fair value through surplus or deficit, including derivatives that are liabilities, are measured at fair value.
- Other financial liabilities are measured at amortized cost using the effective interest method.

###### Gains and losses

A gain or loss arising from a change in a financial asset or financial liability is recognized as follows:

- Where financial assets and financial liabilities are carried at amortized cost, a gain or loss is recognized in surplus or deficit through the amortization process and when the financial asset or financial liability is derecognized or impaired.
- A gain or loss on a financial asset or financial liability classified as fair value through surplus or deficit is recognized in surplus or deficit.

##### 1.5 Inventories

Inventories are measured at the lower of cost and net realizable value.

The cost of inventories comprises all costs of purchase, costs of conversion, and other costs incurred in bringing the inventories to their present location and condition.

Net realizable value is the estimated selling price in the ordinary course of business less the estimated costs of completion and the estimated costs necessary to make the sale.

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Notes to the annual financial statements *for the year ended 30 June 2016*

##### Accounting policies

##### 1.6 Provisions and contingencies

Provisions are recognized when:

- The Institute has an obligation at the reporting period date as a result of a past event;
- It is probable that the Institute will be required to transfer economic benefits in settlement; and
- The amount of the obligation can be estimated reliably.

Provisions are not recognized for future operating losses. Provisions are measured at the present value of the amount expected to be required to settle the obligation. The increase in the provision due to the passage of time is recognized as interest expense.

##### 1.7 Revenue

Revenue is recognized to the extent that it is probable that the economic benefits will flow to the Institute and the revenue can be reliably measured.

Interest is recognized, in profit or loss, using the effective interest rate method.

Donations are recognized as and when received.

Dividends are recognized, in profit or loss, when the Institute's right to receive payment is established.

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

Notes to the annual financial statements  
for the year ended 30 June 2016 (Continued)

#### 2. Property, plant and equipment

	2016			2015		
	Cost/ Valuation	Accumulated depreciation	Carrying value	Cost/ Valuation	Accumulated depreciation	Carrying value
Furniture and fixtures	395 554	(395 152)	36 402	395 554	(351 693)	43 861
Office equipment	28 226	(9 579)	18 647	31 955	(9 579)	22 376
IT equipment	1 312 481	(1 105 388)	207 093	1 181 450	(1 058 473)	122 977
<b>Total</b>	<b>1 736 261</b>	<b>(1 474 119)</b>	<b>262 142</b>	<b>1 608 959</b>	<b>(1 419 745)</b>	<b>189 214</b>

Reconciliation of property, plant and equipment - 2016	Opening balance	Additions	Depreciation	Total
Furniture and fixtures	43 861	-	(7 459)	36 402
Office equipment	22 376	-	(3 729)	18 647
IT equipment	122 977	131 032	(46 916)	207 093
	<b>189 214</b>	<b>131 032</b>	<b>(58 104)</b>	<b>262 142</b>

Reconciliation of property, plant and equipment - 2015	Opening balance	Additions	Depreciation	Total
Furniture and fixtures	53 498	-	(9 637)	43 861
Office equipment	14 239	12 426	(4 289)	22 376
IT equipment	110 760	62 825	(50 608)	122 977
	<b>178 497</b>	<b>75 251</b>	<b>(64 534)</b>	<b>189 214</b>

#### 3. Loan to associate entity

##### Associate Entity

The SAIMM Scholarship Fund	206 468	(215 209)
The loan is unsecured, interest free with no fixed terms of repayment.		

Non-current assets	206 468	-
Non-current liabilities	-	(215 209)
	<b>206 468</b>	<b>(215 209)</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Notes to the annual financial statements for the year ended 30 June 2016 (Continued)

	2016 R	2015 R
<b>4. Other financial assets</b>		
At fair value		
Listed shares	25 231 463	29 830 527
Bonds	2 226 603	2 324 763
	<b>27 458 066</b>	<b>32 155 290</b>
<b>Non-current assets</b>		
At fair value	27 458 066	32 155 290
<b>5. Inventories</b>		
Finished goods	210 487	210 487
<b>6. Trade and other receivables</b>		
Trade receivables	222 044	1 479 448
VAT	160 325	-
Franking machine	21 057	52 943
	<b>403 426</b>	<b>1 532 391</b>
<b>7. Cash and cash equivalents</b>		
Cash and cash equivalents consist of:		
Cash on hand	31 138	26 752
Bank balances	786 103	852 019
Short-term deposits	4 193 606	2 816 154
Investment settlement account	(739 871)	4 200
	<b>4 270 976</b>	<b>3 699 125</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

**Notes to the annual financial statements**  
for the year ended 30 June 2016 (continued)

	2016 R	2015 R
<b>8. Funds</b>		
Balance at beginning of year	4 998 949	4 783 683
Interest received	224 953	215 266
<b>Balance at end of year</b>	<b>5 223 902</b>	<b>4 998 949</b>
Comprising:		
<b>Prof. R.E. Robinson Fund (Book Publications Fund)</b>		
Balance at beginning of year	808 751	773 924
Interest received	36 394	34 827
	<b>845 145</b>	<b>808 751</b>
<b>Brigadier Stokes Memorial Fund</b>		
Balance at beginning of year	7 371	7 053
Interest received	331	318
	<b>7 702</b>	<b>7 371</b>
<b>P.W.J. van Rensburg Memorial Fund (Education Fund)</b>		
Balance at beginning of year	1 226 995	1 174 158
Interest received	55 215	52 837
	<b>1 282 210</b>	<b>1 226 995</b>
<b>MacArthur Forrest Memorial Fund (Awards Fund)</b>		
Balance at beginning of year	516 448	494 208
Interest received	23 240	22 240
	<b>539 688</b>	<b>516 448</b>
<b>INFACON X Research Fund</b>		
Balance at beginning of year	2 217 983	2 122 472
Interest received	99 810	95 511
	<b>2 317 793</b>	<b>2 217 983</b>
<b>SANCOT Fund</b>		
Balance at beginning of year	140 743	134 682
Interest received	6 333	6 061
	<b>147 076</b>	<b>140 743</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Notes to the annual financial statements for the year ended 30 June 2016 (continued)

	2016 R	2015 R
<b>8. Funds (continued)</b>		
<b>The Dave Ortlepp Fund</b>		
Balance at beginning of year	80 658	77 185
Interest received	3 630	3 473
<b>Balance at end of year</b>	<b>84 288</b>	<b>80 658</b>
	<b>5 223 902</b>	<b>4 998 949</b>
<b>9. Operating surplus</b>		
Operating surplus for the year is stated after accounting for the following:		
<b>Operating lease charges</b>		
Premises		
– Contractual amounts	214 839	201 069
Profit (loss) on sale of other financial assets	(204 304)	(571 287)
Profit on exchange difference	(870)	-
Royalties OneMine	(80 418)	(54 093)
Profit on revaluation of non-current assets held for sale	25 631	(498 945)
Depreciation on property, plant and equipment	58 104	64 534
Employee costs	4 734 371	4 146 123
<b>10. Taxation</b>		
No provision has been made for 2016 tax as the Institute is exempt from taxation in terms of Section 10(1)(cB)(i)(ff) of the Income Tax Act.		
<b>11. Cash generated from (used in) operations</b>		
Surplus before taxation	(6 034 222)	13 265
<b>Adjustments for:</b>		
Depreciation and amortization	58 104	64 534
(Profit) loss on sale of assets	(232 513)	(573 171)
Fair value adjustments	25 631	(498 945)
Dividends received	(890 581)	(781 787)
Interest received	(208 003)	(136 914)
Finance costs	111 619	60 371
Movements in provisions	73 449	(16 303)
<b>Changes in working capital:</b>		
Inventories	-	(7 096)
Trade and other receivables	1 128 965	(72 889)
Trade and other payables	1 027 452	(1 555 154)
Deferred income	(51 365)	(30 815)
	<b>(4 991 464)</b>	<b>(3 534 904)</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Notes to the annual financial statements for the year ended 30 June 2016 (continued)

##### Detailed income statement

	2016	2015
	R	R
<b>Revenue</b>		
Revenue	17 827 688	17 308 745
<b>Cost of sales</b>	<b>(18 104 388)</b>	<b>(13 263 913)</b>
<b>Gross profit</b>	<b>(276 700)</b>	<b>4 024 578</b>
<b>Other income</b>		
Administration fees recovered	509 868	320 536
Dividend revenue	890 581	781 787
Fair value adjustments	-	498 945
Gains on disposal of assets	204 304	571 287
Insurance claim refund	-	11 160
Interest received	208 003	136 914
Profit on exchange differences	870	-
Miscellaneous sales	58 290	96 638
Refunds received	177 853	509 721
Royalties OneMine	80 418	54 093
Royalties publications	9 568	11 267
SAMREC/SAMVAL	520	71 791
	<b>2 140 275</b>	<b>3 064 139</b>
<b>Expenses</b>	<b>(7 760 547)</b>	<b>(7 015 081)</b>
<b>Operating profit</b>	<b>(5 896 972)</b>	<b>73 636</b>
Finance costs	(111 619)	(60 371)
Loss on non-current assets held for sale or disposal groups	(25 631)	-
	<b>(137 250)</b>	<b>(60 371)</b>
<b>Profit for the year</b>	<b>(6 034 222)</b>	<b>13 265</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### Detailed income statement

	2016	2015
	R	R
<b>Operating expenses</b>		
AGM medals	(19 090)	(21 025)
Auditor's remuneration	(66 550)	(60 500)
Bad debts	(674 954)	(248 737)
Bank charges	(51 751)	(62 086)
Career guidance	-	(3 000)
Cleaning	(7 572)	(6 675)
Computer expenses	(201 473)	(165 412)
Consulting fees	(35 338)	(51 101)
Council dinner	-	(77)
Delivery expenses	(18 926)	(16 000)
Depreciation, amortization and impairments	(58 104)	(64 534)
Discount allowed	(821)	(183)
Employee costs	(4 734 371)	(4 146 123)
Flowers, plants and decor	(13 624)	(12 003)
General expenses	(17 039)	(118 620)
Insurance	(45 511)	(40 821)
Internet charges	(2 821)	-
Lease rentals on operating lease	(214 839)	(201 069)
Legal expenses	(3 500)	(15 730)
Library services	(17 090)	-
Loss on exchange differences	-	(34 690)
Management fees - investments	(239 965)	(248 570)
Membership internet connection	(62 220)	(60 000)
Membership internet communication	(29 165)	(40 964)
Minor assets written off	-	(1 999)
Office bearers/councillors expenses	(17 816)	(55 586)
Parking expenses	(96 000)	(96 127)
Photocopier expenses	(245 767)	(266 684)
President's expenses	(7 421)	(9 524)
Printing and stationary	(101 223)	(90 511)
Refunds	(15 404)	(61 486)
Repairs and maintenance	(54 040)	(32 969)
Sancot expenses	(14 456)	(41 452)
Scholarship Trust Fund expenses	17 671	-
Secretarial fees	(46 675)	(61 775)
Setcom/paygate charges	(24 016)	(44 211)
Software expenses	(41 543)	(136 642)
Staff expenses	(27 053)	(59 287)
Staff welfare	(34 269)	(35 613)
Student prizes	(11 820)	(16 000)
Subscriptions	(425 717)	(302 909)
Training	(3 425)	(49 395)
Website development/maintenance	(96 849)	(34 991)
	<b>(7 760 547)</b>	<b>(7 015 081)</b>

Mining Studies



ISO 9001:2008



CPRs



Due Diligence  
Scoping Studies



Environmental

Exploration  
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Mineral Resources  
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## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Scholarship Fund (Registration number IT 6837/02)

##### Financial Statements

*for the year ended 30 June 2016*

##### Trustees' responsibilities and approval

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The trustees are required to maintain adequate accounting records and are responsible for the content and integrity of the annual financial statements and related financial information included in this report. It is their responsibility to ensure that the annual financial statements fairly present the state of affairs of the fund as at the end of the financial year and the results of its operations and cash flows for the period then ended, in conformity with the accounting policies of the fund. The external auditor is engaged to express an independent opinion on the annual financial statements.

The annual financial statements are prepared in accordance with the accounting policies of the fund and are based upon appropriate accounting policies consistently applied and supported by reasonable and prudent judgements and estimates.

The trustees acknowledge that they are ultimately responsible for the system of internal financial control established by the fund and place considerable importance on maintaining a strong control environment. To enable the trustees to meet these responsibilities, the trustees set standards for internal control aimed at reducing the risk of error or loss in a cost-effective manner. The standards include the proper delegation of responsibilities within a clearly defined framework, effective accounting procedures, and adequate segregation of duties to ensure an acceptable level of risk. These controls are monitored throughout the fund and all employees are required to maintain the highest ethical standards in ensuring the fund's business is conducted in a manner that in all reasonable circumstances is above reproach. The focus of risk management in the fund is on identifying, assessing, managing, and monitoring all known forms of risk across the fund. While operating risk cannot be fully eliminated, the fund endeavours to minimize it by ensuring that appropriate infrastructure, controls, systems, and ethical behaviour are applied and managed within predetermined procedures and constraints.

The trustees are of the opinion that the system of internal control provides reasonable assurance that the financial records may be relied on for the preparation of the annual financial statements. However, any system of internal financial control can provide only reasonable, and not absolute, assurance against material misstatement or loss.

The external auditor is responsible for independently reviewing and reporting on the Institute's annual financial statements. The annual financial statements have been examined by the Institute's external auditor and his report is presented on page 882.

The annual financial statements set out on pages 883 to 886, which have been prepared on the going concern basis, were approved by the trustees on 2 August 2016 and were signed on their behalf by:

Signed by: J.R. Dixon

Chairman

Signed by:

Vice-chairman

### Audit Report

#### To the members of The SAIMM Scholarship Fund

I have audited the annual financial statements of The SAIMM Scholarship Fund, which comprise the statement of financial position as at 30 June 2016, the statement of comprehensive income, statement of changes in reserves and statement of cash flows for the year then ended, and a summary of significant accounting policies and other explanatory notes, and the trustees' report, as set out on pages 883 to 886.

#### Trustees' responsibility for the annual financial statements

The fund's trustees are responsible for the preparation and fair presentation of these annual financial statements in accordance with the accounting policies of the fund, and for such internal control as the trustees determine is necessary to enable the preparation of annual financial statements that are free from material misstatements, whether due to fraud or error.

#### Auditor's responsibility

My responsibility is to express an opinion on these annual financial statements based on my audit. I conducted my audit in accordance with International Standards on Auditing. Those standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance whether the annual financial statements are free of material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the annual financial statements. The procedures selected depend upon the auditor's judgement, including the assessment of the risk of material misstatement of the annual financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the fund's preparation and fair presentation of the annual financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the fund's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the annual financial statements.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

#### Opinion

In my opinion, the annual financial statements present fairly, in all material respects, the financial position of The SAIMM Scholarship Fund as at 30 June 2016 and its financial performance and its cash flows for the year then ended in accordance with the accounting policies of the fund.

Robert Henry Kitching  
Registered Auditor

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Scholarship Fund (Registration number IT 6837/02)

##### Annual Financial Statements for the year ended 30 June 2016

##### Trustees' report

The trustees submit their report for the year ended 30 June 2016. This report forms part of the annual financial statements.

##### 1. Registration

The fund was registered as a trust on 11 November 2002 with registration number IT 6837/02. The fund can sue and be sued in its own name.

##### 2. Review of activities

##### Main business and operations

- The principal objects of the fund are to:
  - Support and promote, foster and advance the interests of the minerals industry by providing the beneficiaries with funds to be used to support the education of students in the minerals industry;
  - To collect monies and accept contributions in monies or otherwise by way of donations, bequests or otherwise and to apply the same or the income therefrom for all or any of the objects set out in (1) above.
- The principal address of the fund is 5th Floor, Chamber of Mines Building, 5 Hollard Street, Johannesburg. The fund has no full-time employees and is administered by The Southern African Institute of Mining and Metallurgy.

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#### The SAIMM Scholarship Fund (Registration number IT 6837/02)

##### Statement of Financial Position at 30 June 2016

	<i>Note(s)</i>	2016 R	2015 R
<b>Assets</b>			
Current assets			
The Southern African Institute of Mining and Metallurgy	2	-	215 209
<b>Total Assets</b>		<b>-</b>	<b>215 209</b>
<b>Reserves and Liabilities</b>			
<b>Reserves</b>			
Founding settlement		1 000	1 000
Accumulated surplus		(207 468)	214 209
		<b>(206 468)</b>	<b>215 209</b>
<b>Liabilities</b>			
Current Liabilities			
The Southern African Institute of Mining and Metallurgy	2	206 468	-
<b>Total Equity and Liabilities</b>		<b>-</b>	<b>215 209</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Scholarship Fund (Registration number IT 6837/02)

##### Statement of Comprehensive Income

for the year ended 30 June 2016

	<i>Note(s)</i>	2016 R	2015 R
Donations received		23 823	225 000
Donations and expenses		(445 5000)	-
<b>Operating (deficit) surplus</b>		<b>(421 677)</b>	<b>(225 000)</b>
<b>(Deficit) surplus for the year</b>		<b>(421 677)</b>	<b>225 000</b>
Other comprehensive income		-	-
<b>Total comprehensive (loss) income for the year</b>		<b>(421 677)</b>	<b>225 000</b>

##### Statement of Changes in Reserves

for the year ended 30 June 2016

	Founding settlement	Accumulated (deficit)/surplus R	Total reserves R
<b>Balance at 1 July 2014</b>	<b>1 000</b>	<b>(10 791)</b>	<b>(9791)</b>
Changes in reserves			
Total comprehensive deficit for the year	-	225 000	225 000
Total changes	-	225 000	225 000
<b>Balance at 1 July 2015</b>	<b>1 000</b>	<b>214 209</b>	<b>215 209</b>
Changes in reserves			
Total comprehensive deficit for the year	-	(421 677)	(421 677)
Total changes	-	(421 677)	(421 677)
<b>Balance at 30 June 2016</b>	<b>1 000</b>	<b>(207 468)</b>	<b>(206 468)</b>

##### Statement of Cash Flows

for the year ended 30 June 2016

	<i>Note(s)</i>	2016 R	2015 R
<b>Cash flows from operating activities</b>			
Cash generated from (used in) operations		(421 677)	225 000
<b>Cash flows from investing activities</b>			
Loans to group companies		-	(225 000)
Loans advanced		421 677	-
<b>Net cash from investing activities</b>		<b>421 677</b>	<b>(225 000)</b>

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Scholarship Fund (Registration number IT 6837/02)

##### Financial Statements

for the year ended 30 June 2016

##### Accounting policies

#### 1. Presentation of annual financial statements

The annual financial statements have been prepared in accordance with accounting policies of the fund. The annual financial statements have been prepared on the historical cost basis, and incorporate the principal accounting policies set out below. They are presented in South African rands.

These accounting policies are consistent with the previous period.

#### 1.1 Significant judgements

In preparing the annual financial statements, the trustees are required to make estimates and assumptions that affect the amounts represented in the annual financial statements and related disclosures. Use of available information and the application of judgement is inherent in the formation of estimates. Actual results in the future could differ from these estimates, which may be material to the annual financial statements.

#### 1.2 Financial instruments

##### 1.2.1 Initial recognition

The fund classifies financial instruments, or their component parts, on initial recognition as a financial asset, a financial liability or an equity instrument in accordance with the substance of the contractual arrangement.

Financial assets and financial liabilities are recognized on the fund's balance sheet when the fund becomes a party to the contractual provisions of the instrument.

Financial assets and liabilities are recognized initially at cost; transaction costs that are directly attributable to the acquisition or issue of the financial instrument are added to the cost.

##### 1.2.2 Subsequent measurement

After initial recognition, financial assets are measured as follows:

- Loans and receivables and held-to-maturity investments are measured at amortized cost using the effective interest method.
- Investments in equity instruments that do not have a quoted market price in an active market and whose fair value cannot be reliably measured, are measured at cost.
- Other financial assets, including derivatives, at fair values, without any deduction for transaction costs, which may arise on sale or other disposal.

After initial recognition, financial liabilities are measured as follows:

- Financial liabilities at fair value through profit or loss, including derivatives that are liabilities, are measured at fair value.
- Other financial liabilities are measured at amortized cost using the effective interest method.

#### 1.3 Loans receivable/payable

This includes a loan to The Southern African Institute of Mining and Metallurgy; the loan earns no interest, nor does it have any terms of repayment. This loan is carried at cost.

#### 1.4 Revenue

Revenue comprises contributions received from donors and is recognized on receipt.

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Scholarship Fund (Registration number IT 6837/02)

##### Notes to the financial statements

for the year ended 30 June 2016

	2016 R	2015 R
<b>2. Loans to (from) group companies</b>		
<b>Loans payable</b>		
The Southern African Institute of Mining and Metallurgy The loan is unsecured, interest free with no fixed terms of repayment.	(206 468)	215 209
Current assets	-	215 209
Current liabilities	(206 468)	-
	<b>(206 468)</b>	<b>215 209</b>

##### 3. Taxation

The fund is exempt from tax in terms of Section 18A of the Income Tax Act.

# The best blast, on time, every time

The future of mining is electronic initiation

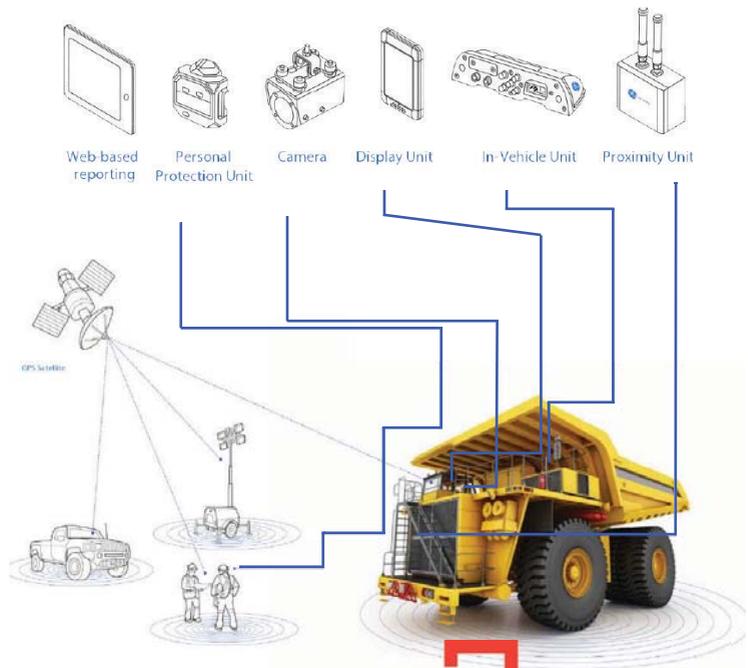


DetNet continues to strive towards excellence in electronic initiation. As a world leader in our field, we aim to deliver the latest technology, consistent quality, and improved loading and fragmentation, all to ensure mining becomes more sustainable today and into the future. You can rely on DetNet to provide the best blast, on time, every time.

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- Proven proximity detection technology that sets new standards for workplace safety and facilitates 'zero harm' objectives.
- Improve operator situational awareness and reduce the incidence of injury.
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- Effective, reliable and intuitive operation.
- Whole of mine solution:
  - OEM independent
  - Stand-alone system
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Johannesburg (HO) Gert - 083 451 0797 / Nic - 082 901 1206

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Tel +27 (0)11 474 0705 Fax +27 (0)11 474 5580 Email [MMSA@maelgwynafrica.com](mailto:MMSA@maelgwynafrica.com) [www.maelgwynafrica.com](http://www.maelgwynafrica.com)



## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Western Cape Branch (Registration number IT 6837/02)

##### Financial Statements

*for the year ended 30 June 2016*

##### Statement of council members' responsibilities and approval

---

The council members are required to maintain adequate accounting records and are responsible for the content and integrity of the annual financial statements and related financial information included in this report. It is their responsibility to ensure that the annual financial statements fairly present the state of affairs of the branch as at the end of the financial year and the results of its operations and cash flows for the period then ended in conformity with the accounting policies appropriate to the Institute. The external auditor is engaged to express an independent opinion on the annual financial statements.

The annual financial statements are prepared in accordance with the accounting policies appropriate to the Institute and are based upon appropriate accounting policies consistently applied and supported by reasonable and prudent judgements and estimates.

The council members acknowledge that they are ultimately responsible for the system of internal financial control established by the branch and place considerable importance on maintaining a strong control environment. To enable the council members to meet these responsibilities, the members set standards for internal control aimed at reducing the risk of error or loss in a cost-effective manner. The standards include the proper delegation of responsibilities within a clearly defined framework, effective accounting procedures, and adequate segregation of duties to ensure an acceptable level of risk. These controls are monitored throughout the branch and all employees are required to maintain the highest ethical standards in ensuring the Institute's business is conducted in a manner that in all reasonable circumstances is above reproach. The focus of risk management in the branch is on identifying, assessing, managing, and monitoring all known forms of risk across the fund. While operating risk cannot be fully eliminated, the branch endeavours to minimize it by ensuring that appropriate infrastructure, controls, systems, and ethical behaviour are applied and managed within predetermined procedures and constraints.

The council members are of the opinion, based on the information and explanations given by management, that the system of internal control provides reasonable assurance that the financial records may be relied on for the preparation of the annual financial statements. However, any system of internal financial control can provide only reasonable, and not absolute, assurance against material misstatement or loss.

The external auditor is responsible for independently reviewing and reporting on the branch's annual financial statements. The annual financial statements have been examined by the Institute's external auditor and his report is presented on page 888.

The annual financial statements set out on pages 889 to 894, which have been prepared on the going concern basis, were approved by the board and were signed on their behalf by:

Signed by: A. Mainza

Chairman

Signed by: C.G. Sweet

Treasurer

### Audit Report

#### To the members of The SAIMM Western Cape Branch

I have audited the annual financial statements of The SAIMM Western Cape Branch, which comprise the statement of financial position as at 30 June 2016, the statement of comprehensive income, statement of changes in reserves and statement of cash flows for the year then ended, and a summary of significant accounting policies and other explanatory notes, as set out on pages 889 to 894.

#### Council Members' responsibility for the annual financial statements

The Institute's council members are responsible for the preparation and fair presentation of these annual financial statements in accordance with the accounting policies appropriate to the Institute, and for such internal control as the council members determine is necessary to enable the preparation of annual financial statements that are free from material misstatements, whether due to fraud or error.

#### Auditor's responsibility

My responsibility is to express an opinion on these annual financial statements based on my audit. I conducted my audit in accordance with International Standards on Auditing. Those standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance whether the annual financial statements are free of material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the annual financial statements. The procedures selected depend upon the auditor's judgement, including the assessment of the risk of material misstatement of the annual financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Institute's preparation and fair presentation of the annual financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the branches internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the annual financial statements.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

#### Opinion

In my opinion, the annual financial statements present fairly, in all material respects, the financial position of The SAIMM Western Cape Branch as at 30 June 2016 and its financial performance and its cash flows for the year then ended in accordance with the accounting policies appropriate to the Institute.

#### Supplementary information

Without qualifying my opinion, I draw attention to the fact that supplementary information set out on page 894 does not form part of the annual financial statements and is presented as additional information. I have not audited this information and accordingly do not express an opinion thereon.

Robert Henry Kitching  
Registered Auditor

## Annual Financial Statements

### The SAIMM Western Cape Branch (Registration number IT 6837/02)

#### Statement of Financial Position

for the year ended 30 June 2016

	Note(s)	2016 R	2015
<b>Assets</b>			
<b>Non-current assets</b>			
Other financial assets	2	559 194	-
<b>Current assets</b>			
Trade and other receivables	3	-	65 887
Cash and cash equivalents	4	559 442	738 037
		<b>559 442</b>	<b>803 924</b>
<b>Total assets</b>		<b>1 118 636</b>	<b>803 924</b>
<b>Reserves and Liabilities</b>			
<b>Reserves</b>			
Retained income		858 198	771 390
<b>Liabilities</b>			
<b>Current liabilities</b>			
The Southern African Institute of Mining and Metallurgy	5	223 351	22 356
Trade and other payables		35 587	10 177
Accruals		1 500	-
		<b>260 438</b>	<b>32 533</b>
<b>Total Equity and Liabilities</b>		<b>1 118 636</b>	<b>803 924</b>

### The SAIMM Western Cape Branch (Registration number IT 6837/02)

#### Statement of Comprehensive Income

for the year ended 30 June 2016

	Note(s)	2016 R	2015
Revenue		473 621	320 859
Cost of sales		(271 094)	(567 142)
<b>Gross loss</b>		<b>202 527</b>	<b>(246 283)</b>
Other income		-	1 703
Operating expenses		(164 577)	(30 755)
<b>Operating surplus</b>	6	<b>37 950</b>	<b>(275 335)</b>
Investment revenue		29 017	28 582
Sponsorship		-	298 696
Fair value adjustments		19 840	-
<b>Surplus for the year</b>		<b>86 807</b>	<b>51 943</b>

## Annual Financial Statements

### The SAIMM Western Cape Branch (Registration number IT 6837/02)

#### Statement of Changes in Reserves

for the year ended 30 June 2016

	Retained income	Total reserves
<b>Balance at 1 July 2014</b>	<b>719 448</b>	<b>719 448</b>
Changes in reserves		
Surplus for the year	51 943	51 943
Total changes	51 943	51 943
<b>Balance at 30 June 2015</b>	<b>771 391</b>	<b>771 391</b>
Changes in reserves		
Surplus for the year	86 807	86 807
Total changes	86 807	86 807
<b>Balance at 30 June 2016</b>	<b>858 198</b>	<b>858 198</b>

### The SAIMM Western Cape Branch (Registration number IT 6837/02)

#### Statement of Cash Flows

for the year ended 30 June 2016

	Note(s)	2016 R	2015
<b>Cash flows from operating activities</b>			
Cash used in operations	8	130 747	(32 348)
Interest income		29 017	28 582
<b>Net cash from operating activities</b>		<b>159 764</b>	<b>(3 766)</b>
<b>Cash flows from investing activities</b>			
Loans advanced to associated entity		200 995	22 356
Purchase of financial assets		539 354	-
<b>Net cash from investing activities</b>		<b>(338 359)</b>	<b>22 356</b>
<b>Total cash movement for the year</b>		<b>(178 595)</b>	<b>18 590</b>
Opening balance on cash and cash equivalents		738 037	719 447
<b>Total cash at end of the year</b>	4	<b>559 442</b>	<b>738 037</b>

# Annual Financial Statements

## The Southern African Institute of Mining and Metallurgy

### The SAIMM Western Cape Branch (Registration number IT 6837/02)

#### Financial Statements

for the year ended 30 June 2016

#### Accounting policies

##### 1. Presentation of Annual Financial Statements

The annual financial statements have been prepared in accordance with accounting policies of the fund. The annual financial statements have been prepared on the historical cost basis. They are presented in South African rands. These is the first year of operations.

##### 1.1 Significant judgements and sources of estimation uncertainty

In preparing the annual financial statements, the trustees are required to make estimates and assumptions that affect the amounts represented in the annual financial statements and related disclosures. Use of available information and the application of judgement is inherent in the formation of estimates. Actual results in the future could differ from these estimates, which may be material to the annual financial statements. Significant judgements include:

#### Provisions

Provisions were raised and management determined an estimate based on the information available.

##### 1.2 Impairment of assets

The Institute assesses at each reporting period date whether there is any indication that an asset may be impaired. If any such indication exists, the Institute estimates the recoverable amount of the asset.

If the recoverable amount of an asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. That reduction is an impairment loss.

An impairment loss of assets carried at cost less any accumulated depreciation or amortization is recognized immediately in surplus or deficit. Any impairment loss of a revalued asset is treated as a revaluation decrease.

##### 1.3 Financial instruments

###### Initial recognition

The Institute classifies financial instruments, or their component parts, on initial recognition as a financial asset, a financial liability or an equity instrument in accordance with the substance of the contractual arrangement.

Financial assets and financial liabilities are recognized on the Institute's balance sheet when the Institute becomes a party to the contractual provisions of the instrument.

Financial assets and liabilities are recognized initially at cost any transaction costs that are directly attributable to the acquisition or issue of the financial instrument are added to the cost.

###### Subsequent measurement

After initial measurement financial assets are measured as follows:

- Loans and receivables and held to maturity investments are measured at amortized cost, less any impairment losses recognized to reflect irrecoverable amounts.

After initial recognition, financial instruments at fair value through surplus or deficit are subsequently measured at fair value, with gains and losses arising from changes in fair value being included in surplus or deficit for the period.

After initial recognition, financial liabilities are measured as follows:

- Financial liabilities at fair value through surplus or deficit, including derivatives that are liabilities are measured at fair value.
- Other financial liabilities are measured at amortized cost using the effective interest method.

###### Gains and losses

A gain or loss arising from a change in a financial asset or financial liability is recognized as follows:

- When financial assets and financial liabilities are carried at amortized cost, a gain or loss is recognized in surplus or deficit through the amortization process and when the financial asset or financial liability is derecognized or impaired.
- A gain or loss on a financial asset or financial liability classified as fair value through surplus or deficit, is recognized in surplus or deficit.

## Annual Financial Statements

### The SAIMM Western Cape Branch (Registration number IT 6837/02)

#### Financial Statements *(continued)* *for the year ended 30 June 2016*

##### 1.4 Provisions and contingencies

Provisions are recognized when:

- The Institute has an obligation at the reporting period date as a result of a past event;
- It is probable that the Institute will be required to transfer economic benefits in settlement; and
- The amount of the obligation can be estimated reliably.

Provisions are not recognized for future operating losses. Provisions are measured at the present value of the amount expected to be required to settle the obligation. The increase in the provision due to the passage of time is recognized as interest expense.

##### 1.5 Revenue

Revenue is recognized to the extent that it is probable that the economic benefits will flow to the Institute and the revenue can be reliably measured.

Interest is recognized, in profit or loss, using the effective interest rate method.

Donations are recognized as and when received.

Dividends are recognized, in profit or loss, when the Institute's right to receive payment has been established.

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Western Cape Branch (Registration number IT 6837/02)

##### Notes to the Annual Financial Statement for the year ended 30 June 2016

	<i>Note(s)</i>	2016 R	2015
2. Other financial assets			
At fair value			
Listed shares		559 194	-
Non-current assets			
At fair value		559 194	-
3. Trade and other receivables			
Trade receivables		-	65 887
4. Cash and cash equivalents			
Cash and cash equivalents consist of:			
Bank balances		13 438	1 050
Short-term deposits		546 004	736 987
		559 442	738 037
5. Loans to (from) associate entity			
Associate entity			
The Southern African Institute of Mining and Metallurgy		(223 351)	(22 356)
The loan is unsecured, interest free with no fixed terms of repayment			
6. Operating surplus			
Operating surplus for the year is stated after accounting for the following:			
Sponsorship		-	(298 696)
Profit on revaluation of non-current assets held for sale		(19 840)	-
Employee costs		68 000	-
7. Taxation			
No provision has been made for 2016 tax as the company is exempt from taxation in terms of Section 10(1)(cB)(i)(ff) of the Income Tax Act.6. Operating surplus			
8. Cash generated from (used in) operations			
Profit before taxation		86 807	51 943
Adjustments for:			
Fair value adjustments		(19 840)	-
Interest received		(29 017)	(28 582)
Changes in working capital:			
Trade and other receivables		65 887	(65 887)
Trade and other payables		25 410	10 178
Accruals		1 500	-
		130 747	(32 348)

## Annual Financial Statements

### The Southern African Institute of Mining and Metallurgy

#### The SAIMM Western Cape Branch (Registration number IT 6837/02)

##### Detailed Income Statement for the year ended 30 June 2016

	<i>Note(s)</i>	2016 R	2015
<b>Revenue</b>			
Revenue	-	314 280	
MINPROC - registrations		459 542	-
MINPROC - social events		1 579	-
Hydrometallurgy workshop		-	6 579
MINPROC - workshop		12 500	-
		473 621	320 859
Cost of sales		(271 094)	(567 142)
Gross profit (loss)		202 527	(246 283)
<b>Other income</b>			
Fair value adjustments		19 840	-
Interest received		29 017	28 582
Social events		-	1 703
Sponsorship		-	298 696
		48 857	328 981
<b>Operating expenses</b>			
Adjustments/write-offs		(64 387)	-
AGM costs		(2 429)	-
Auditor's remuneration		(5 000)	-
Bank charges		(2 723)	(2 488)
Catering - meetings		(660)	-
Committee dinner		(1 755)	-
Computer expenses		(4 768)	(3 000)
Consulting fees		-	(6 203)
Credit card machine hire		(3 544)	(3 579)
Employee costs		(68 000)	-
Student evening		-	(10 250)
Telephone		(3 000)	-
Website development/maintenance		(8 311)	(5 235)
		(164 577)	(30 755)
Profit for the year		86 807	51 943

# The Southern African Institute of Mining and Metallurgy

is proud to present the

## 14<sup>th</sup> Annual Student Colloquium

25 October 2016 · Mintek, Randburg



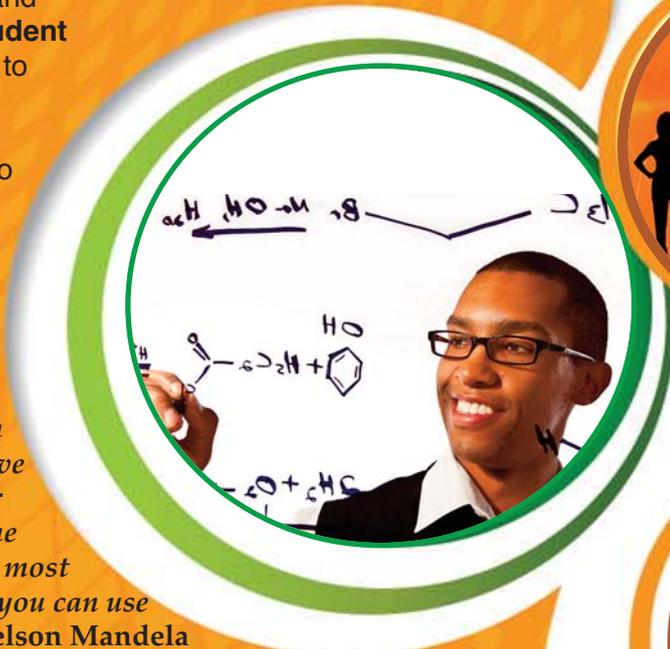
### The Southern African Institute of Mining and Metallurgy

has been organising and presenting an annual **Student Colloquium** since 2002, to give the best final year mining and metallurgical students an opportunity to present their final year projects to a mining and metallurgical audience.

*Our students today, are our young professionals tomorrow and will have a fundamental impact on the way we work. We have to support and assist our young professionals of the future! 'Education is the most powerful weapon which you can use to change the world' - Nelson Mandela*

The SAIMM cordially invites our experts in the field to meet the fine calibre of young professionals about to embark on their careers in the industry. There will be 11 mining and 11 metallurgical presentations planned for the day, which will include a lunch and at the end of the day and a prize giving function. The top five winners of each discipline will stand a chance to be published in the prestigious SAIMM Journal in April 2017.

*Our strategy is the following: To contribute to the creation of prosperous and empowered young professionals.*



**1 ECSA  
CPD point will be  
allocated to all  
attending  
delegates**



**Supported by**



**For further information contact:**  
Head of Conferencing, Raymond van der Berg  
Saimm, P O Box 61127, Marshalltown 2107  
Tel: +27 (0) 11 834-1273/7  
E-mail: raymond@saimm.co.za  
Website: <http://www.saimm.co.za>

# Colloquium Announcement



## UNLOCKING THE FUTURE OF THE AFRICAN MINERALS INDUSTRY: VISION 2040

### KEYNOTE SPEAKERS AND TOPICS

#### Leadership

**Davis Cook**, CEO,  
Research Institute for  
Innovation and Sustainability

#### Innovation

**Gary Lane**, Co-founder  
and Group CEO, NXGN

#### Professional Development

**Nosipho Siwisa-Damasane**, CEO  
- Richards Bay Coal Terminal  
**Thabile Makgala**, Vice President -  
Gold Fields

### BACKGROUND

It is recognised that we live in an era characterised by accelerated change, overwhelming complexities and tremendous competition, all of which result in considerable uncertainty about the future. The challenge for young professionals in this time is to create a vision for mining in Africa that will inspire confidence for the future. Young professionals must create a roadmap that describes the steps necessary to realise the vision. In setting the strategic direction to achieve the vision, these are a few of the questions that must be answered:

- What are the policies that should be developed and implemented to transform the status quo to the envisioned mining environment?
- What are the technical solutions that need to be pursued?
- What are the human capital needs that must be satisfied?
- What are the economic conditions required?

This conference will provide a platform for young professionals to interact with peers and industry thought leaders to drive the dialogue towards unlocking the future of the African minerals industry.

### HOW TO REGISTER

Complete the registration form and return to [anna@saimm.co.za](mailto:anna@saimm.co.za) or [camielah@saimm.co.za](mailto:camielah@saimm.co.za)

Take advantage of the Early Bird registration discount.  
Book before 2 February 2017 to qualify.

### EXHIBITION/SPONSORSHIP

Sponsorship opportunities are available. Companies wishing to sponsor or exhibit should contact the Conference Co-ordinator.

### WHO SHOULD ATTEND

This conference should be of value to all professionals across the entire minerals industry value chain, including:

- Exploration
- Geology
- Mining
- Mineralogy
- Geotechnical engineering
- All metallurgical fields
- SHE practitioners
- Industrial relations and community involvement

# INTERNATIONAL ACTIVITIES

## 2016

**27 September 2016** — Global Mining Standards and Guidelines Group 'Underground Mining Forum'  
Wits Club, University of the Witwatersrand, Johannesburg  
Contact: Raymond van der Berg  
Tel: +27 11 834-1273/7  
Fax: +27 11 838-5923/833-8156  
E-mail: raymond@saimm.co.za,  
Website: <http://www.saimm.co.za>

**19–21 October 2016** — AMI Ferrous and Base Metals Development Network Conference 2016  
Southern Sun Elangeni Maharani, KwaZulu-Natal, South Africa  
Contact: Raymond van der Berg  
Tel: +27 11 834-1273/7  
Fax: +27 11 838-5923/833-8156  
E-mail: raymond@saimm.co.za  
Website: <http://www.saimm.co.za>

**25 October 2016** — 14th Annual Student Colloquium  
Mintek, Randburg  
Contact: Raymond van der Berg  
Tel: +27 11 834-1273/7  
Fax: +27 11 838-5923/833-8156  
E-mail: raymond@saimm.co.za  
Website: <http://www.saimm.co.za>

## 2017

**9–10 March 2017** — 3rd Young Professionals Conference  
Innovation Hub, Pretoria, South Africa  
Contact: Camielah Jardine  
Tel: +27 11 834-1273/7  
Fax: +27 11 838-5923/833-8156  
E-mail: camielah@saimm.co.za  
Website: <http://www.saimm.co.za>

**9–12 May 2017** — 6th Sulphur and Sulphuric Acid 2017 Conference  
Cape Town, South Africa  
Contact: Camielah Jardine  
Tel: +27 11 834-1273/7  
Fax: +27 11 838-5923/833-8156  
E-mail: camielah@saimm.co.za  
Website: <http://www.saimm.co.za>

**25–28 June 2017** — Emc 2017: European Metallurgical Conference  
Leipzig, Germany  
Contact: Paul-Ernst-Straße  
Tel: +49 5323 9379-0  
Fax: +49 5323 9379-37  
E-mail: EMC@gdmg.de  
Website: <http://emc.gdmdb.de>

**6–7 June 2017** — Mine Planning School 2017  
Gauteng  
Contact: Raymond van der Berg

Tel: +27 11 834-1273/7  
Fax: +27 11 838-5923/833-8156  
E-mail: raymond@saimm.co.za  
Website: <http://www.saimm.co.za>

**27–29 June 2017** — 4th Mineral Project Valuation Colloquium  
Mine Design Lab, Chamber of Mines Building,  
The University of the Witwatersrand, Johannesburg  
Contact: Raymond van der Berg  
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Fax: +27 11 838-5923/833-8156  
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Website: <http://www.saimm.co.za>

**24–25 July 2017** — Chrome School 2017  
Gauteng  
Contact: Raymond van der Berg  
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**August 2017** — Rapid Underground Mine & Civil Access 2017 Conference  
Gauteng  
Contact: Raymond van der Berg  
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**11–13 September 2017** — Uranium 2017 International Conference  
Swakopmund, Namibia  
Contact: Raymond van der Berg  
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E-mail: raymond@saimm.co.za  
Website: <http://www.saimm.co.za>

**2–7 October 2017** — AfriRock 2017: ISRM International Symposium 'Rock Mechanics for Africa'  
Cape Town Convention Centre, Cape Town  
Contact: Raymond van der Berg  
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Fax: +27 11 838-5923/833-8156  
E-mail: raymond@saimm.co.za  
Website: <http://www.saimm.co.za>

**25–27 October 2017** — AMI Precious Metals 2017 'The Precious Metals Development Network (PMDN)'  
Gauteng, South Africa  
Contact: Raymond van der Berg  
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Fax: +27 11 838-5923/833-8156  
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Website: <http://www.saimm.co.za>

## Company Affiliates

The following organizations have been admitted to the Institute as Company Affiliates

3 M South Africa	eThekweni Municipality	New Concept Mining (Pty) Limited
AECOM SA (Pty) Ltd	Exxaro Coal (Pty) Ltd	Northam Platinum Ltd - Zondereinde
AEL Mining Services Limited	Exxaro Resources Limited	PANalytical (Pty) Ltd
Air Liquide (PTY) Ltd	FLSmith Minerals (Pty) Ltd	Perkinelmer
AMEC Foster Wheeler	Fluor Daniel SA ( Pty) Ltd	Polysius A Division Of Thyssenkrupp Industrial Sol
AMIRA International Africa (Pty) Ltd	Franki Africa (Pty) Ltd-JHB	Precious Metals Refiners
ANDRITZ Delkor (Pty) Ltd	Fraser Alexander Group	Rand Refinery Limited
Anglo Operations (Pty) Ltd	Geobruigg Southern Africa (Pty) Ltd	Redpath Mining (South Africa) (Pty) Ltd
Arcus Gibb (Pty) Ltd	Glencore	Rocbolt Technologies
Aurecon South Africa (Pty) Ltd	Goba (Pty) Ltd	Rosond (Pty) Ltd
Aveng Engineering	Hall Core Drilling (Pty) Ltd	Royal Bafokeng Platinum
Aveng Mining Shafts and Underground	Hatch (Pty) Ltd	Roymec Global (Pty) Ltd
Axis House Pty Ltd	Herrenknecht AG	RungePincockMinarco Limited
Bafokeng Rasimone Platinum Mine	HPE Hydro Power Equipment (Pty) Ltd	Rustenburg Platinum Mines Limited
Barloworld Equipment -Mining	IMS Engineering (Pty) Ltd	Salene Mining (Pty) Ltd
BASF Holdings SA (Pty) Ltd	Ivanhoe Mines SA	Sandvik Mining and Construction Delmas (Pty) Ltd
BCL Limited	Joy Global Inc.(Africa)	Sandvik Mining and Construction RSA(Pty) Ltd
Becker Mining (Pty) Ltd	Kudumane Manganese Resources	SANIRE
BedRock Mining Support Pty Ltd	Leco Africa (Pty) Limited	SENET (Pty) Ltd
Bell Equipment Limited	Longyear South Africa (Pty) Ltd	Senmin International (Pty) Ltd
Blue Cube Systems (Pty) Ltd	Lonmin Plc	Smec South Africa
Caledonia Mining Corporation	MAGOTTEAUX (PTY) LTD	SMS group Technical Services South Africa (Pty) Ltd
CDM Group	MBE Minerals SA Pty Ltd	Sound Mining Solution (Pty) Ltd
CGG Services SA	MCC Contracts (Pty) Ltd	South 32
Concor Mining	MD Mineral Technologies SA (Pty) Ltd	SRK Consulting SA (Pty) Ltd
Concor Technicrete	MDM Technical Africa (Pty) Ltd	Technology Innovation Agency
Cornerstone Minerals Pty Ltd	Metalock Engineering RSA (Pty) Ltd	Time Mining and Processing (Pty) Ltd
Council for Geoscience Library	Metorex Limited	Tomra (Pty) Ltd
Cronimet Mining Processing SA (Pty) Ltd	Metso Minerals (South Africa) Pty Ltd	Ukwazi Mining Solutions (Pty) Ltd
CSIR Natural Resources and the Environment (NRE)	MineRP Holding (Pty) Ltd	Umgeni Water
Data Mine SA	Mintek	Vietti Slurrytec (Pty) Ltd
Department of Water Affairs and Forestry	MIP Process Technologies (Pty) Ltd	Webber Wentzel
Digby Wells and Associates	MSA Group (Pty) Ltd	Weir Minerals Africa
DRA Mineral Projects (Pty) Ltd	Multotec (Pty) Ltd	Worley Parsons RSA (Pty) Ltd
DTP Mining	Murray and Roberts Cementation	
Duraset	Nalco Africa (Pty) Ltd	
Elbroc Mining Products (Pty) Ltd	Namakwa Sands(Pty) Ltd	

# Forthcoming SAIMM events...

## EXHIBITS/SPONSORSHIP

Companies wishing to sponsor  
and/or exhibit at any of these  
events should contact the  
conference co-ordinator  
as soon as possible

For the past 120 years, the Southern African Institute of Mining and Metallurgy, has promoted technical excellence in the minerals industry. We strive to continuously stay at the cutting edge of new developments in the mining and metallurgy industry. The SAIMM acts as the corporate voice for the mining and metallurgy industry in the South African economy. We actively encourage contact and networking between members and the strengthening of ties. The SAIMM offers a variety of conferences that are designed to bring you technical knowledge and information of interest for the good of the industry. Here is a glimpse of the events we have lined up for 2016. Visit our website for more information.

## SAIMM DIARY

### 2016

- ◆ **Forum**  
Global Mining Standards and Guidelines Group  
'Underground Mining Forum'  
27 September 2016, Wits Club, University of the Witwatersrand, Johannesburg
- ◆ **CONFERENCE**  
AMI Ferrous and Base Metals Development Network  
Conference 2016  
19-21 October 2016, Southern Sun Elangeni Maharani, KwaZulu-Natal
- ◆ **COLLOQUIUM**  
14th Annual Student Colloquium  
25 October 2016, Mintek, Randburg

### 2017

- ◆ **CONFERENCE**  
3rd Young Professionals Conference  
9-10 March 2017, Innovation Hub, Pretoria
- ◆ **CONFERENCE**  
6th Sulphur and Sulphuric Acid 2017 Conference  
9-12 May 2017, Cape Town
- ◆ **SCHOOL**  
Mine Planning School 2017  
6-7 June 2017, Gauteng
- ◆ **COLLOQUIUM**  
4th Mineral Project Valuation Colloquium  
27-29 June 2017, The University of the Witwatersrand, Johannesburg
- ◆ **SCHOOL**  
Chrome School 2017  
24-25 July 2017, Gauteng
- ◆ **CONFERENCE**  
Rapid Underground Mine & Civil Access 2017  
August 2017, Gauteng
- ◆ **CONFERENCE**  
Uranium 2017 International Conference  
11-13 September 2017, Swakopmund, Namibia
- ◆ **SYMPOSIUM**  
AfriRock 2017: ISRM International Symposium 'Rock  
Mechanics for Africa'  
2-7 October 2017, Cape Town Convention Centre, Cape Town
- ◆ **CONFERENCE**  
Precious Metals 2017 'The Precious Metals Development  
Network (PMDN)'  
25-27 October 2017, Gauteng, South Africa



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THE SOUTHERN AFRICAN INSTITUTE  
OF MINING AND METALLURGY

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#### HYDRAULIC PROP FOR ROCKBURST AND ROCKFALL CONDITIONS

- Blast on prop up to 2.0 meters
- Light weight
- Easy installation
- 89mm Diameter
- Controlled yielding
- Safe remote installation
- Superb energy absorption
- Cannot be over extended
- Resilient in rock burst conditions

*Can be reinstalled if necessary – resulting in significant cost saving for any mine.*

#### UNDERGROUND PERFORMANCE

- Props withstood numerous recorded seismic events from 0.5 to 1.8 magnitude
- Props were installed on a production panel with zero blast out and no visible damage to the props
- The props remained operational after 200mm of closure

### Remote Drill Rig

- Built-in drill rig jack  $\pm$  80kg force for stability
- 5 meter remote drilling operation
- Reduced noise levels due to remote drilling
- No vibration of machine on operator
- Operation of rig from supported area
- One man operation
- Accurate drilling due to stability of drill rig
- Selection of rock drills can be used
- Rigs are bolt-on modular
- Reliable unit
- Drill cradle set low to ensure drill is as close to ground as possible ensuring fewer drill steel change overs
- Low repair cost
- Service exchange units available
- Rock drills can be supplied on request
- Rig fitted with an extension foot piece for increased working heights
- Large wheels for ease of transportation and handling
- Supplied with a lubricator attached to rig
- Significant cost saving



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