Department of Mining Engineering
Research Summary 2013

Executive Summary

The use of industry experts that were appointed on a part time basis to help the department with postgraduate studies was very well received by the students. Industry experts got involved with the academic program and specifically in research related activities. This is also of value in the research activities within the Guided Special Studies module.

In the field of mining there are many collaborative and cross-cutting research initiatives. Mining related research by various departments in its Faculty of Engineering, Built Environment and Information Technology continue.

The establishment of a Chair in Safety and Health and Environment from Sasol mining will definitely create further research opportunities and a Noise induced hearing loss and Change Management research projects have been initiated. The need for a chair in Rock Engineering was identified. In 2013 Harmony Gold agreed to sponsor a chair in Rock Engineering. In this program industry directed research into specific Rock Engineering problems and the associated solutions will be directed.

The department is also involved in the following research areas with industry leaders within each of the mentioned disciplines:

- Mechanisation and Automation
- Rock-breaking and Explosive engineering
- Management and Leadership
- Safety and Health
- Risk Management
- Mine Ventilation Engineering
- Rock Engineering.

The department is also in process to establish a Virtual Reality mine design centre primarily from sponsorship from Kumba and the University itself. This will include the building of offices and facilities for the mining department on top of the current Mineral Sciences building. Making new facilities available will further enhance the potential of the department to become a world leader in, specific identified research themes and also bolster our training capabilities as well as providing a first in terms Virtual reality training in Africa.

The department is there for continuous its growth phase with a lot of emphasis on establishing the infrastructure to ensure a sustainable future with regards student numbers growth and research activities. The department is also continuing with the establishments of its Mineral Resources Resilience Institute (MRRI) so as to further our footprint in the mining industry globally. This initiative will have as part of its delivery strategy support and enhance our teaching ability, foster and grow our research capability and further our consulting activities.

Introduction

In 2013 the use of industry experts that were appointed on a part time basis to help the department with postgraduate studies continued. This was very well received by the students as industry experts got involved with the academic program (especially with regards research related activities, required from the Guided Special Studies module). Figure 1 shows a breakdown of the research capabilities and the environment in which postgraduate students can be assisted with in their studies within in the Department of Mining Engineering.

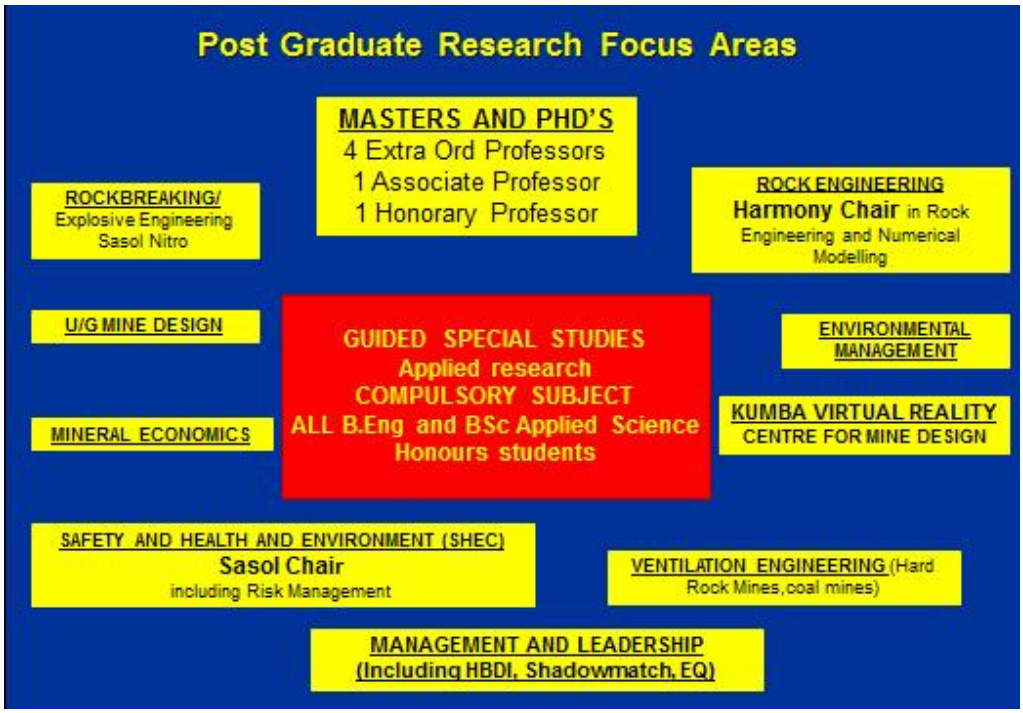

Figure 1: Post graduate research focus areas

The establishment of a chair in Safety and Health and Environment from Sasol mining and the filling of the Chair in December of 2013 will create further research opportunities. Research within the noise reduction and the impact on noise induced hearing loss (NIHL) continued in 2013 and will roll over into 2014. Change Management research projects have been initiated. Sasol Mining increased the chair amount with R4.5 million in December 2013, so as to enable the appointment of Professor Jan du Plessis as chair holder.

The need for a chair in Rock Engineering identified in 2012 came to fruition in 2013 when Harmony Gold agreed to sponsor the Chair in Rock Engineering. This position was filled by Mr Johan Hanekom. The value of this sponsorship is R4.7 million.

The department also in secured funding from Kumba Iron ore to establish a Kumba Virtual Reality mine design centre. This funding together with funding from the University of Pretoria will also establish new office facilities for the mining department on top of the current Mineral Sciences building. The new facilities available will further enhance the potential of the department to become a world leader in specific identified research areas.

The department remains in a growth phase with a lot of emphasis on establishing of infrastructure that will ensure a sustainable future both considering student numbers growth and research activities. The department is also in the process of establishing a Mineral Resources Resilience Institute (MRRI) so as to further our footprint in the mining industry globally. This initiative will have as part of its strategy, teaching, research and consulting activities.

It is important to note that department has a number of staff that is still junior in terms academic development and their associated academic profile (when one considers it from a pure research prospective). This is in stark contrast when one considers the department's staff complement and their associated mining experience. All of the staff members are busy with advancing their academic careers. Three of the staff members (lecturers), have honours degrees (all registered for their Masters degrees in mining engineering), two Masters degrees, (both registered for their PhD's), two senior lecturers with between 20 and 30 years of mining experience, to be registering for their honours/Masters degrees and two PhD (associate professors). In the last three years we have appointed 4 extra ordinary Professors (now three as one migrated into the department) so as to further enhance the academic profile and research related activities in the department. This forms the building blocks for the foundation for establishing an academic team that would be in a position to enhance the research output of the department in the future. Historically the department was not known to deliver a high number of research outputs annually. This will change as the initiatives bed down and research work is initiated. The year 2013 was the first year, that the Department had a full staff complement and the necessary admin support staff in place, generously sponsored by the mining industry. The MQA also agreed in sponsoring 2 academic lecturer positions for HDSA's until 2016.

In addition to this we have also put in place a further new requirement for graduation of our B.Eng(Hons) Mining Engineering students and that is that all registered students will have to submit an article for publication with their respective department supervisors, before they would be allowed to graduate. This will ensure that we will increase the number of potential publications in future. All of these new initiatives have never been done before and will really improve the research output related publications per annum in future.

The department further boasts with the highest number of postgraduate students ever (which also includes the highest number of Honours, Masters and PhD students ever). This is clearly shown in Figure 2. The prospects for 2013 are even better.

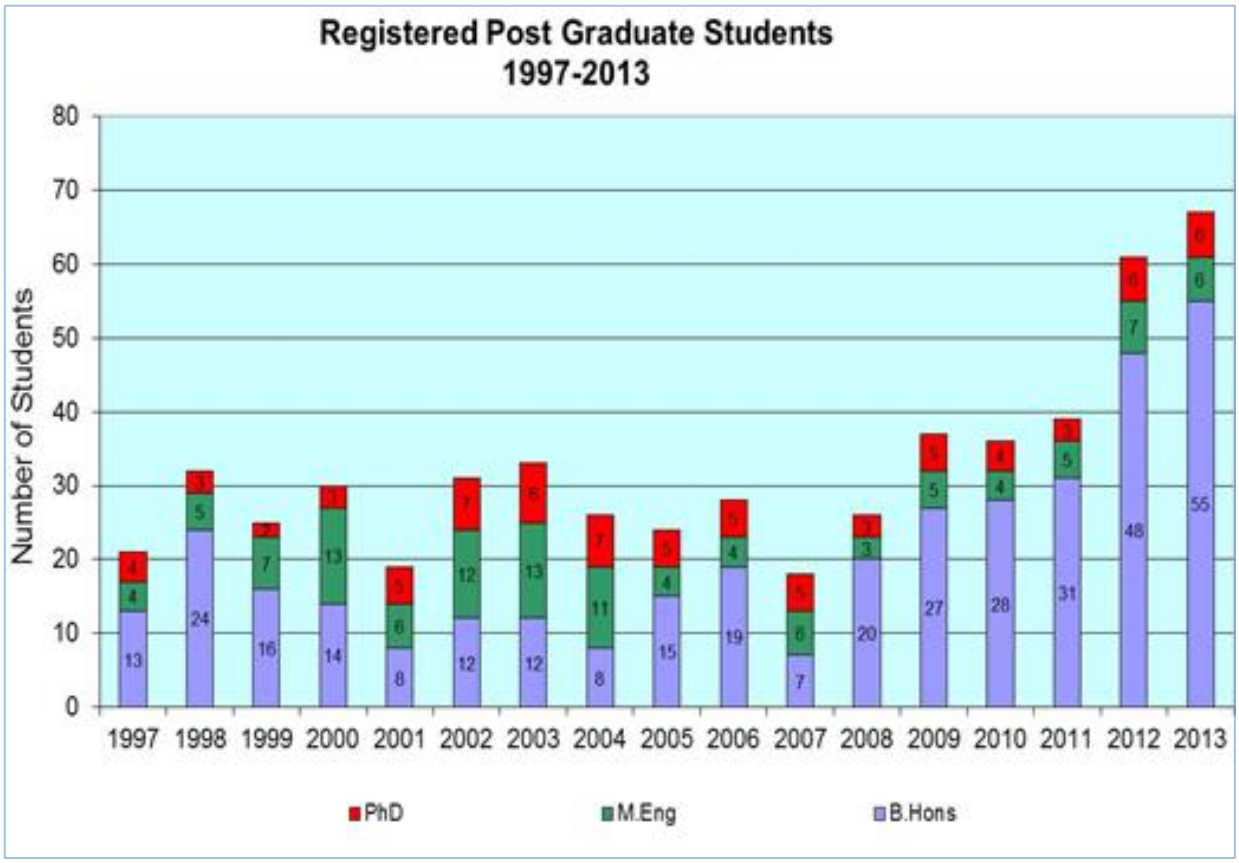

Figure 2: Post graduate students in Mining Engineering

Table 1 shows a breakdown of the research related topics and progress with regards our PhD and Masters students.

Table 1: Research in progress, publications pending and in progress (2013 continuing 2014)

TITLE (PhD research)	NAME	PROGRAM	Status	Supervisor
Development Of A Reliable Artificial Neural Network Cost Model For Surface Coal Mines	Mussa Budeba	PhD: Mining Publication 2013		Prof. R. Webber-Youngman Prof. Yadivalli (potentially)
Underground Coal Mining Methods and Design Guideline to Best Practice including an Evaluation of Key Performance Indicators	Andre Dougall	PhD: Mining (new registration)		Prof. R Webber-Youngman Prof. Con Fauconnier
Pillar Design for general Geotechnical Conditions in Hard and Soft Rock Mines in South Africa	Kumendrie Naidoo	PhD: Mining (new registration)		Prof. F. Malan Prof. J. Napier
Environmental Impacts Valuation from Chinese Mining Projects context in Southern Africa	Jean-Rene Thisekedi	PhD: Mining Engineering	On Hold	Prof. R. Webber-Youngman Prof. Con Fauconnier
Optimising Shaft Pressure Losses through Computational Fluid Dynamic Modelling	William Kempson	PhD: Mining Engineering COMPLETED, article presented to SAIMM 2013		Prof. R. Webber-Youngman Prof. J Meyer
The Design and Behaviour of Crush Pillars on the Merensky Reef	Michael du Plessis	PhD: Mining Engineering Publication 2013		Prof. F. Malan Prof. J. Napier
	Johan Hanekom	PhD: Mining Engineering		
TITLE (M.Eng/MSc research)	**NAME**	**PROGRAM**		**Supervisor**
An investigation into the influence of shear stress on pillar strength - Board and pillar mining	Jannie Maritz	M.Eng: Mining Engineering Publication	Completion 2014	Prof. F. Malan Prof. J. Napier
Underground Bulk Air Heat Exchanger criteria and selection guide	Marle Hooman	M.Eng: Mining Engineering Publication submitted to SAIMM	Completed Graduation early 2014	Prof. R Webber-Youngman Prof. J du Plessis
Mechanical Rock Breaking in Hard Rock Narrow Reef Stopes	Wolter de Graaf	M.Eng: Mining Engineering Publication 2013	Completion 2014	Dr. A. Leuschner Prof. William Spiteri
The optimization of Budget Schedules in Surface Mining	Johann Hager	M.Eng: Mining Engineering	Completed Under examination	Prof. R Webber-Youngman Prof. Yadivalli
A Modified Sequential Grid Layout To Increase Production Rates In Deep Level Hard Rock Mines	Yolande Jooste	M.Sc: Applied Science: Mine Strata Control to be Completed and publication 2013		Prof. F. Malan Prof. J. Napier
A critical evaluation of people transport systems for decline shafts	Gawie van Heerden	M.Eng: Mining Engineering to be completed and publication 2013		Prof. R. Webber-Youngman
Prevention of Spontaneous Combustion in raw coal storage bunker	Mervin Govender	Msc : Mining Engineering		Prof. J du Plessis

Honours degree projects

Table 2 below shows a summary of the 2013 and Table 3 the current Honours degree applied research topics and their relevant students and supervisors. As mentioned before a further requirement for this year is that all B.Eng(Hons) mining students (as compulsory), will have to provide proof of publication with their respective supervisors, which will definitely have a major impact on the publication output of the department.

Table 2: Honours degree topics 2013

Surname	*Name*	*Topic*	*Supervisor*
Aipanda	Tomas	An Analysis of Specific Drill and Blast Cost Improvement Strategies at Rossing Uranium Mine	Wolter de Graaf
Bilankulu	Charmaine	Evaluation of the Potential Impact that Aquila can Provide on the Drilling Processes of a Coal Mine	Pierre Bredell
de Wahl	Hugo	The Viability of Mechanisation at Anglo Platinum Siphumelele 1	Martiens van Staden
Fox	Martyn	A Strategy to Gradually Mechanise an Aging Conventional Hard Rock Tabular Platinum Mine	Martiens van Staden
Maphalla	Emmanuel	Optimising Design Parameters for Hard Rock Room-and-Pillar Methods	Frik de Frey
Mashilo	Jacob	Final Wall Blasting Methods in Surface Mines	William Spiteri
Mokhobo	Tumelo	The Investigation of Long-Term Brine Water Management Options at New Denmark Colliery	Jan du Plessis
Mongoma	Mothusi	Noise Reduction in Underground Coal Mines through Noise Control Engineering for a Fan Scrubber	Jan du Plessis
Nkhiphitheni	Ramukakate	Continuous Miner Cutting in In-Seam Sandstone at Brandspruit Mine, Section 87	Clive Knobbs
Peta	Mitchelle	The Occurrence of Fall of Grounds (FOGs) at Vertical Shaft (Bokoni Platinum Mines)	James Roberts
Potgieter	Stefanus	Dust Suppression at the Skorpian Zinc Mine	Jan du Plessis
Roodt	Diederick	An Investigation into Change Management Practices at Sasol During the Implementation of a New Safety System	William Spiteri
Seema	Koloi	The Proposal of Timberless Support for the Second Underground Trial in Extra Low Profile (XLP)Section of Bathopele Mining Project	Jannie Maritz
Lehasa	Lehlohonolo	The effect of dozing cost on the overall waste hauling operational cost	Pierre Bredell

Table 3: Honours degree topics 2014

	Student No	Last Name	Name Initials	Title	Program and Plan	Title
1	26265509	Brink	D (Desiré)	Mrs	BEng (Hons)	MODELLING THE IMPACT OF FRAGMENTATION ON IN-PIT COSTS AT MINE X*
2	99073294	Erasmus	GB (Gert)	Dr	BSc(Hons): Appl Sci	Raising funds for a mining feasibility study
3	4428552	Guliwe	MG (Mxolisi)	Mr	BEng (Hons)	Optimising blast- and dozer gain in order to make mining of currently uneconomical coal resources economically viable with specific focus on Jicama Block D
4	29205299	Kagogo	TS (Theophelus)	Mr	BEng (Hons)	A FEASIBILITY STUDY INTO THE IMPLEMENTATION OF TULIP PLUGS AT ROSSING URANIUM MINE
5	10142682	Kekana	KT (Katlego)	Mr	BEng (Hons)	A PROPOSED METHOD TO DEVELOP THROUGH HEX RIVER FAULT AT IMPALA MINE SHAFT 16#
6	20146443	Keulder	K (Kobus)	Mr	BSc(Hons): Appl Sci	CONTRACTOR VERSUS OWNER MINING AT UNITED MANGANESE OF KALAHARI
7	4408411	Kgaphola	MMJ (Mabole)	Mr	BEng (Hons)	
8	13343263	Lekgema	AN (Alexia)	Miss	BSc(Hons): Appl Sci	THE ANALYSIS OF STOPE AND DEVELOPMENT ROCK SUPPORT SYSTEMS
9	27420273	Makua	SM (Stephen)	Mr	BSc(Hons): Appl Sci	AND ROOF BOLTER VERSUS THE AUTO ROCK DRILL MACHINE
10	28162766	Moleko	EL (Edwin)	Mr	BEng (Hons)	Comparing the current conventional development end drilling methods and the newly proposed mechanized Tunnel boring machine (TBM) method at Mponeng Mine
11	28291949	Muridili	DA (Dakalo)	Mr	BEng (Hons)	The shape effect and rock mass structural control for mine pillar design
12	12238385	Muteba	TB (Tshala)	Mr	BSc(Hons): Appl Sci	OPTIMIZATION OF ROCK BLASTING DESIGN IN OPEN PIT MINES NEARBY COMMUNITIES
13	25318472	Ndaba	NN (Nomfundo)	Ms	BEng (Hons)	The Applicability of The Highwall Mining Method In Exxaro Coal Mines
14	29081255	Neser	MH (Megan)	Ms	BEng (Hons)	AN INVESTIGATION INTO THE LEVEL OF MATURITY OF VIRTUAL REALITY EDUCATION IN THE SOUTH AFRICAN MINING INDUSTRY
15	22246666	Netshirando	T (Tshifhiwa)	Miss	BSc(Hons): Appl Sci	PSA EXTENSION- LOST BLAST IMPROVEMENT
16	12282864	Nkomba	KCF (Kiwila)	Mr	BSc(Hons): Appl Sci	RETREAT PILLARS USING HYDRAULIC FILL AT KAMOTO MINE
17	10501585	Preis	EP (Eugene)	Mr	BEng (Hons)	AN INVESTIGATION INTO THE DETERMINATION OF THE REAL COST OF ACCIDENTS AT BHP BILLITON ENERGY COAL SOUTH AFRICA (BECSA) OPEN-CAST COAL MINES (PLANNER PROPOSAL)
18	28177526	Ramashau	PE (Phumudzo)	Mr	BEng (Hons)	A literature study on an equipment used for blast performance assessment in a surface mine operation
19	28304943	Sekata	NP (Nchaeng)	Mr	BEng (Hons)	SLOPE MANAGEMENT AT LETŠENG DIAMOND MINE
20	13044282	Shai	M (Matsie)	Ms	BSc(Hons): Appl Sci	Slope design for the South Pyroxenite Pit using Rock Mass Classification and kinematic analysis at Foskor Mine, Phalaborwa
21	29065195	Tonkin	CJ (Christopher)	Mr	BEng (Hons)	A critical investigation into the buckling and structural integrity of a semi engineered elongate
22	27353312	Van Niekerk	R (Ruaan)	Mr	BEng (Hons)	Investigation of Re-drilling at Middelburg Colliery
23	28314761	van Niekerk	HAC (Hendrik)	Mr	BEng (Hons)	ELECTRONIC DETONATORS IN SURFACE MINING
24	10093002	van Zweel	W (Wynand)	Mr	BEng (Hons)	AN INVESTIGATION INTO THE EFFECTIVENESS OF THE FOOTWALL DUST-ALLAYING ON THE INLET AIRWAYS AT KHUTALA COLLIERY

Journal and/or Conference proceeding Department of Mining Engineering in 2013

Although in 2013 we had fewer publications we have a full pipeline for 2014. Below is a list of published papers for 2013:

1. De Graaf, W.W. 2013. Blast induced damage mechanism on final walls and the blasting methods to minimise damage. Proceedings of the 2013 International Symposium on Slope Stability in Open Pit Mining and Civil Engineering, Brisbane, Australia, 25 – 27 September 2013.
2. Du Plessis, J.J.L., Hoffman D., Marx, W.M. and van der Westhuizen, R. 2013. Optimising ventilation and cooling systems for an operating mine using network simulation models. Association of Mine Managers of South Africa. Rustenburg South Africa.
3. Gordeliy, E., Piccini, R., Napier, J.A.L. and Detornay, E. 2013. Axisymmetric benchmark solutions in fracture mechanics. Engineering fracture mechanics, 102, April: pp. 348 – 357.
4. Kempson, W., Webber-Youngman, R.C.W. and Meyer, J.P. 2013. Optimising shat pressure losses through computational fluid dynamics modelling. Journal of the Southern African Institute of Mining and Metallurgy, 113 (12), December: pp. 931 - 939.
5. Malan, D.F. and Napier, J.A.L. 2013. Recent advances in numerical modelling to simulate on-reef failure processes in deep tabular mines. Minesafe 2013 beyond 2013 Milestones, Johannesburg, South Africa 22 – 24 October.
6. Napier, J.A.L. and Detournay, E. 2013. Propagation of non-planar pressurised cracks from a borehole. Research and applications in Structural Engineering, Mechanics and Computation, Cape Town, 2 – 4 September 2014.
7. Webber-Youngman, R.C.W. and van Wyk, E. 2013. Incident reconstruction simulations-potential impact on the prevention of future mine incidents. Journal of the Southern African Institute of Mining and Metallurgy, 113 (6), June: pp. 519 – 528.

2014 – Current Publication outlook

The outlook for 2014 is indicating a very healthy pipeline of publications and the publication of a textbook where the staff has had a hand in twelve of the chapters.

Presented Papers

1. ***Du Plessis, J.J.L*** and Spath H.S. Active barrier performance preventing methane explosion propagation. Proceedings of the Coal Operators Conference. 12 -14 February 2014. Wollongong. New South Wales. Australia.

Planned Papers

1. ***Budeba, M***. Modelling and determining the technical efficience of surface coal mine supply chain. Proceedings of the Society of Mining Professors Conference, June 2014.
2. De Wet, J.R., Mackay, L., ***du Plessis, J.J.L***., and Bluhm, S. and Walter, K. 2014. Cooling options for a deep Platinum Group Metals mine in the Bushveld Igneous Complex. Journal of the Southern African Institute of Mining and Metallurgy (date TBA)
3. ***Du Plessis, J.J.L***. and Marx, W.M. 2014. Energy Efficient Ventilation and Cooling of Mines. Proceedings of the Society of Mining Professors Conference, June 2014.

4. ***Du Plessis, J.J.L***. and Marx, W.M. 2014. Mine ventilation system optimisation considering optimal energy, health and safety. To be published in the proceedings of the 10th International Mine Ventilation Congress, Sun City, South Africa.
5. Hager, J., Yadavalli, V.S.S. and ***Webber –Youngman, R.C.W***. 2014. Stochastic Simulation for Budget Prediction for Large Surface Mines in the South African Mining Industry
6. Hooman, M., ***Webber-Youngman, R.C.W., du Plessis, J.J.L.*** and Marx W.M. 2014. A decision analysis guideline for underground bulk air heat exchanger design specification. Journal of the Southern African Institute of Mining and Metallurgy (date TBA)
7. ***Knobbs, C***. and Gerryts, E. 2014. The Sasol Engineering Leadership academy (SELA). Proceedings of the Society of Mining Professors Conference, June 2014.
8. ***Mabapa, R.R***. 2014. Opencast coal mining integrated rehabilitation planning. Proceedings of the Society of Mining Professors Conference, June 2014.
9. ***Maritz, J.A***. 2014. The presence of shear stresses in pillars and the effect on factor of safety in a room and pillar layout. Proceedings of the SOMP Conference, June 2014.
10. **Neser, M**. 2014. An Investigation into the level of Maturity of Virtual Reality Education in the South African Mining Industry.
11. ***Preis, E.P.*** 2014 An investigation into the determination of the real cost of accidents at BHP Billiton Energy Coal South Africa (BECSA) open-cast coal mines
12. ***Webber-Youngman, R.C.W***. and van Heerden, G.M.J. 2014 Engineering Principles for the Design of a new Mine's Personnel Transportation System.

Textbook

1. ***Du Plessis, J.J.L.*** Editor, Mine Ventilation and Occupational Environment Engineering, to be published in 2014. This textbook consists of 45 Chapters authored by National and International Experts. Author and Co- Author of nine Chapters listed below:
    a. **Chapter 1** - *Fundamentals of Fluid Flow* by V.A.L. Chasteau and Prof. ***J.J.L. du Plessis***
    b. **Chapter 2 -** *Thermodynamic Aspects of Mine Airflow* by R. Hemp and Prof. ***J.J.L. du Plessis***
    c. **Chapter 7 -** *Basic fan engineering* by J.H. De La Harpe, Ed Chessor, and Prof. ***J.J.L. du Plessis.***
    d. **Chapter 12** - *The Properties and Effects of Dust* by Prof ***J.J.L. du Plessis*** and Dr. B. K. Belle
    e. **Chapter 13 -** *Occupational Exposure Limits for Airborne Pollutants* by D.W. Stanton, Prof. ***J.J.L. du Plessis*** and Dr B.K. Belle
    f. **Chapter 14** - *Sampling of Airborne Dust and Diesel Particulates* by Prof. ***J.J.L. du Plessis*** and Dr B.K. Belle
    g. **Chapter 15 -** *Methods of Dust Control* by Prof. ***J.J.L. du Plessis***, Dr B.K. Belle and K. Dekker
    h. **Chapter 25** - Chilled water Reticulation by R.M. Stroh, R. Ramsden and Prof. ***R.C.W. Webber-Youngman***
    i. **Chapter 26 -** *Gases Encountered in Mines* by Prof. ***J.J.L. du Plessis*** and K Beukes

j. **Chapter 28 -** *Explosible Dusts and Mine Explosion Prevention* by Prof .***J.J.L. du Plessis***, Prof. H.R. Phillips, Dr B.K. Belle and Prof. K Lebecki

k. **Chapter 33 -** Mine Ventilation Economics by M.J. Howes, ***R.C. W. Webber-Youngman*** & J. Janse van Rensburg

l. **Chapter 35 -** Water Management in Mining by Prof. ***R.C.W. Webber-Youngman.***