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BRIEF RÉSUMÉ – LEENDERT (LEON) LORENZEN (PhD)

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PERSONAL

Name	Leendert (Leon) Lorenzen
Birth	Virginia, Free State, South Africa, 11 November 1960
Citizenship	Australian
Languages	Fluent in English and Afrikaans

PROFESSIONAL SUMMARY

I have more than 31 years' in-depth experience in mineral processing, chemical engineering, electrochemistry, reactive systems, hydrometallurgy, waste treatment and biofuels, particularly with regard to application of these technologies in the process industries and in-depth exposure, through high performance teams, to exploration, economic geology, mineralogy and mining.

As a highly motivated and positive person, I strive for success in all aspects of my life. I am a pragmatic self-starter who can manage situations on my own, while appreciating the value of a strong team and the importance of open and honest communication. I have the ability to adapt and manage to new situations quickly in order to achieve outstanding results.

I am a very dedicated and purpose driven individual. I am also very organized and have the ability to attract a high performance team. I have the ability to combine the strong points of colleagues with my strong points to be an effective manager and strong leader, but at the same time giving them full credit for their contributions towards achieving a common goal. I am also good at strengthening my weaker points with the strong points of colleagues in order to make sure the sum of my team is greater than its parts. In modern management practice, this natural ability to combine strengths and to be an effective manager at the same time as being a strong leader is very important. I always look at the bigger picture and the interests of the institution rather than just my own individual interests.

My excellent linkages to various industries and universities, together with my very good interpersonal and management skills were pivotal in the successful completion of various studies and projects. Many people in the past have described my success as a researcher, manager and leader to my natural ability to manage. I know how to identify opportunities, whether technical, commercial or organisational, and have a talent to bring all the elements together in an effective system-like manner to exploit such opportunities. As a result of that I interact very effectively with industry, business and academic worlds at all levels. I am very effective in solving project-related and interpersonal problems both at the inter-institutional and intra-organisational levels. I am a people's person who understands the needs of individuals. With some excellent administrative and very good financial skills, I place high priority on compliance management, proper governance and due process. I see myself as a meticulous organiser who loves to work and motivates people working for and with me to ensure deadlines are met through continuous encouragement of staff under pressure so that a win-win outcome is achieved for all.

My management style is that I usually consult widely and involves all parties in decision-making, but at the end of the day I am not afraid to take a strong leadership role in coming to a decision. In this respect, I see myself as a very effective Chairman and facilitator.

KEY STRENGHTS

- Extensive management and working experience in mineral processing, chemical engineering, waste management, water management and renewable energy sectors with an extensive and deep exposure to exploration and mining.
- Trusted advisor to all levels within the mining and chemical industries as well as finance and academic institutions.
- Strong written and verbal communication skills including writing peer reviewed research papers, industrial reports, due diligence reports, management reports, etc., as well as competent and confident in public speaking roles.
- Professionally registered to operate in many countries and recognised as Competent Person and Qualified Person in the fields of Chemical Engineering and Mineral Processing Internationally.
- Genuine leadership ability and proved track record in positions of responsibility.
- Extremely well organised and able to plan effectively and meet deadlines trough prioritising tasks and efficient time management.
- Determination to succeed coupled with high emotional intelligence and effective planning and trust, ensures that goals are successfully met even under pressure situations.
- Equally at ease working within a team environment, working as sole charge role or in charge of a team to reach common goals.
- High regard for health and safety issues and strong supporter and enforcer of professional ethics and confidentiality.
- Colleagues and peers see me as a very good facilitator and team builder. I therefore facilitate meetings and strategic planning sessions on a regular basis.
- A record of successful collaboration projects and programmes with internationally recognised experts in mineral processing.
- Extensive experience in managing and co-ordinating multi-disciplinary and integrated research programmes and industry projects covering all aspects of the mineral value chain, i.e. exploration and geology, mining and planning, geometallurgy and geophysics, processing, infrastructure and optimisation across the value chain.
- Innovative thinker.

PROFESSIONAL WORK CAPABILITIES

Management and Board Capabilities

- Acting Dean and Deputy Dean of Engineering (8 years).
- Director and Chairman of Board of Directors - Prolor Techpros Pty Ltd (10 years).
- Owner of Lorenzen Engineering Consultants and Lorenzen Consultants (15 years).
- Director (non-executive) of Various Companies - Sunspace, UML, Centre for Process Engineering, etc. (various times over 20 years) – some are spin-off companies from Universities.
- Chairman of the Board of Directors of all the Research Institutes/Centres reporting to the Faculty of Engineering and Science at Stellenbosch University (12 Centres) (8 years).
- Head and Chairman of Chemical Engineering and Mineral Processing Department/School (8 years).
- Chairman of various Professional Organisations/Societies Branches (various times over 30 years).
- Group General Manager and Manager in various industries (more than 10 years).
- Chairman of International Conferences (IMPC, World Gold, SAIChE, etc.).
- Chairman of various committees and groups within various organisations (25 years).

Research Capabilities

- Advisor and consultant to industry technology groups (more than 20 years).
- Working as researcher within industry (5 years).
- Managing research, technology and innovation within industry (4 years).
- Managing research groups within academic research environment (17 years).
- Design of research programmes and projects (more than 30 years).
- Author and co-author of 76 papers in international peer reviewed journals with a SCOPUS h-Index of 20.
- Author and co-author of 3 patents.
- Author and co-author of 3 book chapters.

- Author and co-author of 80 peer reviewed papers in proceedings of international conferences.
- Editor of Conference Proceedings (IMPC 2003, World Gold 2005 and World Gold 2013).
- Author and co-author of more than 105 research reports.
- Delivered more than 200 papers at national and international conferences.
- Delivered in the region of 30 workshops and training courses to industry.
- Keynote presenter on various occasions at international conferences.

Academic Capabilities

- Professor in Chemical Engineering and Mineral Processing (17 years).
- Professor Extraordinary at Stellenbosch University (8 years).
- Study leader or co-study leader of 53 master's students and 20 PhD students who completed their studies (20 years).
- Supervisor for 11 Post-doctoral and other researchers (17 years).
- Advisory Boards of various academic institutions (more than 20 years).
- Author and presenter of short courses, workshops and training to industry (25 years).

Consulting Capabilities

- Work as consultant in all sectors mentioned in key strengths since 1990 (**trusted advisor**).
- Can sign off as Competent Person and Qualified Person in most countries, both in Chemical and Mineral Processing Industries (10-15 years).
- Completed many independent engineering studies, due diligence studies, high technical reviews, and independent technical reviews for financiers, professional services groups and executives of companies (more than 10 years).

Operational Capabilities

- Process plant experience in area of mineral processing and systems engineering sectors (3 years).
- Trouble shooting and re-engineering in brownfields operations (over 30 years).
- Design of testwork programmes and procedures within existing operations (over 30 years).

Design Capabilities

- Design of testwork programmes for studies and process plant designs (20 years).
- Flowsheet development and sign off on process designs (3 years).
- Plant expansions and changes (15 years).

HONORS AND AWARDS

Received among other the following awards and honours:

- Medal awarded for the best paper at the Second International Conference on Hydrometallurgy (ICHM '92), China - 1992 (two papers were presented by myself at the conference on behalf of a colleague).
- Evaluated as a B category (internationally acclaimed) researcher by the National Research Foundation in South Africa.
- Medal awarded for Researcher of the Year, Faculty of Engineering, University of Stellenbosch, South Africa (1996).
- Medal awarded for Lecturer of the Year, Faculty of Engineering, University of Stellenbosch (1999).
- Vice-Chancellor's Award for Excellence in Research, University of Stellenbosch (2002).
- SAIMM Silver Medal for the best journal article published in South African Institute of Mining and Metallurgy (SAIMM) Transaction Papers (2005).
- Co-author of best poster paper at Mineral Processing 2006, Cape Town., South Africa.
- Co-author of best poster paper at South African Institute of Chemical Engineers, research and Development Symposium, Cape Town, 2007.
- Two authored papers have been awarded the Minerals Engineering Top 25 papers (2011 and 2012) and another paper the Chemical Engineering Top 25 (2007).

PUBLICATIONS AND REPORTS (Full detail list of all publications are available as an Appendix on request)

- Author and co-author of 76 papers in international peer reviewed journals.
- Author and co-author of 3 patents.
- Author and co-author of 3 book chapters.
- Author and co-author of 80 peer reviewed papers in proceedings of international conferences.
- Editor of Conference Proceedings (IMPC, 2003, World Gold 2005 and World Gold 2013).
- Author and co-author of more than 105 research reports.
- Delivered more than 200 papers at national and international conferences.
- Delivered in the region of 30 workshops to industry.
- Study leader or co-study leader of 53 master's students and 20 PhD students who completed their studies.
- Supervisor for 11 Post-doctoral and other researchers.

EXPERIENCE

PROFESSIONAL EXPERIENCE

Registrations

- Registered as Professional Chartered Engineer with the Institution of Engineers Australia (**CPEng**)
- Qualified Person (**QP**) with AusIMM and SAIMM
- Competent Person (**CP**) both in Chemical Engineering and Mineral Processing
- Registered as a Professional Engineer in South Africa (**PrEng**)
- Registered as a Chartered Engineer with the British Engineering Council (**CEng**)

Membership of Professional Organisations/Societies

- Fellow of the Australasian Institute of Mining and Metallurgy (**FAusIMM**)
- Fellow of the Institution of Engineers Australia (**FIEAust)**
- Graduate Member of the Australian Institute of Company Directors (**GAICD**)
- Fellow of the Institute of Chemical Engineers (British) (**FIChemE**)
- Fellow of the South African Academy of Engineering (**FSAAE)**
- Fellow of the SA Institute of Mining and Metallurgy (**FSAIMM**)
- Fellow of the SA Institution of Chemical Engineers (**FSAIChE**)

WORKING EXPERIENCE

Current Position(s)

- Executive Consultant – Lorenzen Consultants
- Executive Consultant – Mintrex Pty Ltd
- Professor Extraordinary in Mineral Processing at Stellenbosch University in South Africa

June 2015 to present, Lorenzen Consultants, Perth, Australia
Executive Consultant

My work focusses on providing worldwide expert advice to industry, financial institutions, consulting businesses, research organisations, universities on various aspects of mining and processing namely: innovation, technology advise, research advice, mineralogy, geometallurgy, metallurgy, optimisation, de-bottlenecking, throughput and recovery predictions, technical due diligence studies, technical and process plant audits (high technical reviews), NI43-101 compliant technical reports, competent person's reports and independent engineering reviews. I recently conducted high level work for the folowing companies, namely Northern Star, BHP Billiton Technology (TGP&E), AngloGold Ashanti, Curtin University and Newmont.

July 2015 to present, Mintrex Pty Ltd, Subiaco, Perth, Australia
Executive Consultant (Casual)

My work focusses on providing worldwide expert advice via Engineering Design Company Mintrex, to industry, financial institutions, consulting businesses and various organisations on various aspects of mining and mineral processing with specific focus on optimisation, de-bottlenecking, throughput and recovery predictions and design.

September 2013 to June 2015, Mintrex Pty Ltd, Subiaco, Perth, Australia
Manager of Project and Studies

I joined Mintrex in September 2013 and was responsible for the development of the process engineering capability of the company covering due diligence work, direct consultancy services for grass roots, developing and operating mines and the process design of new plants. I am also responsible for the management of all studies and projects conducted within Mintrex. As project manager or director I am/was responsible for a variety of studies and projects (brownfields and greenfield) recently for the following companies, namely Phoenix (Castle Hill Gold Project), Excelsior (Kalgoorlie North Gold Project), Roxgold (Yaramoka Project in Africa), Sandfire (DeGrussa Copper Mine – various projects), Northern Star (Paulson's, Plutonic, Jundee and various project and consultant on their Gold Mines), Papillion (Fekola Gold Project), West African Resources (Mangarka5 Gold Project), AngloGold Ashanti (Tropicana and Sunrise Dam Gold Plants), Goldfields (various Gold Mines) and Hot Chili (Productora Copper Project), just to name a few. In addition to the metallurgical processing design work, my work also focuses on mineralogy, throughput and recovery predictions, technical due diligence studies, technical and process plant audits (high technical reviews), NI43-101 compliant technical reports, competent person's reports and independent engineering reviews for clients worldwide.

December 2009 – August 2013 – Snowden Mining Industry Consultants, Perth, Australia
Group General Manager – Metallurgy and Corporate

I started with Snowden in Perth as an executive consultant doing metallurgy consulting at the executive level, and particularly in the space between geology and pure metallurgy/mineral processing (Geometallurgy). My work mostly focused on mineralogy, throughput and recovery predictions, technical due diligence studies, technical and process plant audits (high technical reviews), NI43-101 compliant technical reports, competent person's reports and independent engineering reviews for clients worldwide. Some completed projects include Mintails High Technical Review, Meekatharra Due Diligence and listing, Bronzewing Due Diligence, Ma'aden Ad Duwayhi Feasibility Study, Jabiru Metals Technical review, Royal Bafokeng Rasomine Mine Technical Review, Galaxy Independent Engineering Evaluations, Galaxy NI 43-101, Severstal Pre-Feasibility Study, to mention a few. I was also the Group General Manager (Globally) responsible for all metallurgical work in the Snowden Global Group. I was also appointed to run the Innovation Board of Snowden since 2011, and my responsibility was the innovation and research programmes within Snowden and with associated partners and universities.

February 2009 – November 2009 - BHP Billiton Nickel West, Stainless Steel Materials (SSM), Perth, Australia
Innovation and Project Manager

I was transferred to BHP Billiton Nickel West, Business Development and Projects Division in February 2009 after the closure of Perth Technology Centre (PTC). My main duties were the management of the Ore Characterisation (Metallurgy and Mineralogy) side of future expansion projects as well as new mining projects for Nickel West. New metallurgical tools and algorithms to be used in mining models using drill core data, reserve model data as well as extraction and process data obtained from testwork programme were developed. I was also responsible for the project management of the IP portfolio of BHP Billiton as a group.

Sept 2008 – February 2009 – BHP Billiton, Stainless Steel Materials (SSM), Perth Technology Centre, Perth, Australia
Manager Nickel Technology and Metallurgy Manager

I joined BHP Billiton Global Technology in September 2008, first as Manager Nickel Technology (in Newcastle) but was appointed within two months as Metallurgy Manager and Hydrometallurgy Manager at Stainless Steel Materials, Perth Technology Centre (PTC) due to the closure of Global Technology by

BHP Billiton in Newcastle. My main areas of responsibilities were to establish a research facility of interest to SSM, identify and collaborate with other world class research facilities in areas or interest to SSM and put agreements in place to collaborate on areas of mutual interest. Develop a project management system and procedure at PTC as well as develop a matrix research operational structure. I was also responsible for research in hydrometallurgy, pyrometallurgy and mineral processing of interest to SSM and help SSM assets with problem solving on their sites by conducting and facilitating research on various problems. Identification of new technologies and ideas through networking and innovation was also one of my main priorities.

Sept 1998 – August 2008 – Prolor Techpros (Pty) Ltd, Technology Park, Stellenbosch, South Africa
Managing Director and Chairman of the Board of Directors

Managing Director and Chairman of the Board of Directors of Prolor Techpros (Pty) Ltd (Consulting Company) – Programme and project management, strategic planning, environmental management, re-engineering, corporate governance, training.

Jul 1995 – August 2008 - Stellenbosch University, Department of Process (Chemical and Metallurgical) Engineering, Stellenbosch South Africa
Professor (also Chairman during that period)/Deputy Dean/Acting Dean

From July 1995 my main tasks were management, undergraduate teaching and research. During this time I lectured the following subjects for undergraduate students: Thermodynamics, Reactor Kinetics, Final Year Project, Final Year Plant Design, Hydrometallurgy, Project Management; Technology Management, Innovation and Environmental Engineering. I also acted as supervisor for masters and doctoral students during that time and the funding of the projects listed below which were mostly industry funded projects (as indicated in brackets). I acted as the project leader for the following research projects during this time:

Hydrometallurgy (leaching)

- Evaluation of the Hot Acid Leach Process at the Namakwa Sands Mineral Separation Plant (Namakwa Sands – Anglo American).
- A fundamental evaluation of the atmospheric pre-leaching section of the nickel-copper matte treatment process (Impala Platinum).
- The leaching of solid wastes to determine the effectiveness of immobilising heavy metals and organic materials.
- The effect of copper on the degradation of cyanide in soils (Harmony).
- The control of calcium and magnesium in a Base metal Sulphate leach solution (old AVMIN).
- The development of a diagnostic leaching tool incorporating an uranium liberation model for Vaal River Ores (AngloGold Ashanti).
- Removal of heavy metals and solvents from crud and slime dam material (AngloGold Ashanti).

Mineral Processing

- Feasibility study proposal for the establishment of a protocol for particulate sampling and analysis of the gas stream from the reverberatory furnace (Phalabora Mining Company (PMC).
- The effect of physical parameters on the rupture of bubble films in two-phase foams (De Beers Research Laboratories).
- The adsorption characteristics of precious and base metals on four different ion exchange resins (Impala Platinum).
- The use of ion-exchange resins for the recovery of valuable species from slurries of sparingly soluble solids (Impala Platinum).
- The systems engineering of automated fire assay laboratories for the analysis of precious metals (Anglo Platinum).

- Determination of the liquidus temperatures in the iron-rich portion of the Co-Cu-Ni-Fe-Se Alloy system (Mintek).
- The modelling of mass transfer and equilibrium controlled competitive elution from activated carbon (BHP Billiton).
- The modelling of mass transfer and equilibrium controlled competitive elution from activated carbon (CSENSE now GE).
- The modelling of the response of a resin in pulp reactor (Mintek).
- The optimisation of milling techniques for ilmenite ore (Kumba Resources).
- Some aspects of ferrohydrostatic separation of minerals and the recycling of ferrofluid (De Beers Research Laboratories).
- Modelling and control of an autogenous mill using state space methodology and neural networks (Anglo Platinum).
- Chromium deportment in copper matte equilibrated with CrxO-containing slag (Mintek).
- Simulating the Various Jug Separators Efficiency on a Specific Ore Sample (Kumba Resources).

Impinging Stream/Jet Reactors

- Evaluation of Jet Impingement Technology as a replacement for the general carbonation process in sugar refining (Sugar Milling Research Institute).
- The development and modelling of jet reactors (Sasol Technology).
- The development and modelling of impinging stream reactors for effective mass transfer (Sasol Technology).
- The design of a jet reactor for the treatment of gold ores (Mintek).
- Ex-situ soil washing of Diesel contaminated soil using impinging stream reactors and selective soft self attrition (National research Foundation).

Membranes

- Preparation and characterisation of palladium composite membranes (Sasol Technology).
- Optimising catalyst and membrane performance and performing a fundamental analysis on the dehydrogenation of ethanol and 2-butanol in a catalytic membrane reactor (Sasol Technology/CNRS - France).
- Evaluation and improvement of dehydrogenation conversion and isomerisation selectivity in an extractor Catalytic Membrane Reactor (CNRS – France).
- Modelling of the transport phenomena in an air gap membrane distillation unit (Water research Council).
- Ultrasonic-time-domain-reflectometry as a real time non-destructive visualisation technique of concentration polarisation and fouling of reverse osmosis membranes (Water Research Council).
- The manufacture and evaluation of ceramic membranes (National Research Foundation).
- The development of a membrane reactor for the dehydrogenation of isopropanol (Sasol Technology).
- Modified electroless plating technique for preparation of palladium composite membranes (CNRS – France /NRF).
- Characterisation and optimisation of Catalytic Membrane Reactor for *m*-xylene isomerisation over Pt-ZSM-5 Zeolite catalyst (CNRS- France/NRF).

Waste Management/Environmental Engineering

- Optimisation of the Ion Exchange Juice Treatment Plant at Ashton (Ashton Cellars).
- Treatment of Cellar Effluent at Fredericksburg Wine Estate (Rupert and Rothschild International).

- The commissioning, evaluation and optimisation of a dissolved air flotation (DAF) pilot plant for the treatment of winery effluent (Rupert and Rothschild International).
- The development of an audit procedure and treatment technologies for Rupert and Rothschild Vignerons' Winery wastewater (Rupert and Rothschild International).
- The development of an integrated management plan for the handling, treatment and purification of effluent in the wine, spirits and grape juice industries (Winetech).
- Evaluation and commissioning of a sedimentation unit for winery effluent treatment (Rupert and Rothschild).
- The detoxification and immobilisation of solid and liquid wastes by reactive polymerisation (Siloxo now Zeobond – Australia).
- An Integrated Approach to Waste and Energy Minimization in the Wine Industry: A Knowledge-Based Decision Methodology (Winetech).
- The immobilisation of inorganic pollutants in fly-ash and other waste components.
- The immobilisation of heavy metal ions in metallurgical wastes.
- Ex-situ bioremediation of hydrocarbon contaminated soil using the biopile technique (CSIR).
- Degradation characterisation of various geo-chemical matrices during leaching (Siloxo now Zeobond – Australia).
- The immobilisation of organic waste by geopolymerisation (Siloxo now Zeobond – Australia).
- Durability and diffusive behaviour evaluation of geoplymeric materials (Siloxo now Zeobond – Australia).
- An investigation of the chemistry involved in the mixing of an industrial effluent with fine ash (Sasol Technology).
- The utilisation of the ash disposal system as a salt sink: Enhancement and optimisation of chemical interactions (Sasol Technology).
- A critical process analysis of wine production to improve cost, efficiency wine quality and environmental performance (Winetech).
- Advantages associated with the implementation and integration of environmental management systems in small manufacturing businesses (Winetech).
- Process development and commissioning of a bioreactor for mass culturing of USAB granules by process induction and microbial stimulation (Water Research Council).
- The development of an integrated management system in the personal care products industry (Winetech).
- Evaluation of primary and secondary treatment of distillery (Winetech).

Water

- Provision of point source water by air-gap membrane distillation (Water Research Council).
- Preliminary design guidelines for the development of a granulating bioreactor (Water research Council).

General

- The development, design, building and commissioning of a small scale (5 l/hr) ferromagnetic-fluid (FMF) plant (water and kerosene base) - Phase I: Development and design (De Beers Research Laboratories).
- Alternative value products from cheap and distilling wine (Prolor Techpros (Pty) Ltd).
- The use of ion exchange resin for pH modification in the effluent from the wine press (Twee Jongengezellen Wine Estate).
- The stabilization of Wine Musts by Ion Exchange: Development of a Pilot Batch Reactor (Report to Twee Jongengezellen Wine Estate).

- Tartrate stabilization of wine musts using ion exchange (Report to Twee Jongengezellen Wine Estate).
- Molecular simulation of thermodynamics in liquid mixtures - A mean field approach (Sasol Technology).
- The development of a reactor for the manufacture of zinc electrodes for a silver oxide-zinc battery (Denel).
- The bio-disposal of lignocellulose substances with activated sludge (University).
- Project radicalness and maturity: A contingency model for the importance of enablers to technological innovation (National Research Foundation).
- Evaluation of vibrating plate extraction column performance by application of a steady state and unsteady state backflow models (AECI).
- Discolouring of Grape Juice Concentrate – Causes and Possible ways of inhibitions (KWV).
- Extraction Ethanol from distilling wine (NRF).

Renewable Energy

- Identification of extraction methods for the production of humic acids from black liquor (Prolor Techpros).
- An economic feasibility study of biodiesel plants in Southern Africa (Prolor Techpros).
- The economic feasibility of commercial biodiesel production in South Africa including sensitivity analysis for important plant and related parameter (SANERI).
- Pilot plant and process simulation of heterogeneous biodiesel production (Logichem).
- Biofuels Process Development Evaluation and Optimization (Sunfuels/Biodiesel One).
- The development of a biofuels engine testing laboratory and the effect of various biofuels on the fuel handling system in diesel engines (SANERI/VW SA).
- Commissioning and optimisation of a small scale biodiesel plant (SANERI/Prolor Techpros).

Most of the research projects that I have supervised at the University of Stellenbosch (in the department and centre) were sponsored by, and conducted in collaboration with South African mining, chemical, wine, spirits and juice companies. Sponsors included: Anglo American Corporation of S.A. Ltd, Anglo American Research Laboratories, De Beers Ltd, De Beers Research Laboratories, Gencor Ltd, Impala Platinum Ltd, Sasol Ltd, Sastech, Iscor Ltd, CSIR, Rössing Ltd, Transhex Ltd, Lonrho Ltd (Lonmin), Goldfields of S.A. Ltd, Palaborwa Mining Company, Eskom, Chamber of Mines of S.A (Mineral Education Fund Trust), Winetech, KWV, Rupert and Rothschild, Various Wine Cellars, Water Research Commission, Amplats, Avmin, Afrox, AngloGold Ashanti, Anglo Research, Nufcor, etc. Research grants were also received on a competitive basis from state funded agencies such as the NRF (FRD), THRIP and Mintek. Although many of these projects resulted in publications on new theory in international journals, a part of the practical work was conducted on operating plants. This approach enhanced the transfer of research results to the operating staff, and ensured that the research remained relevant to industry.

During the period 1991 to 2007, I raised research funding for my own research group from outside the University of Stellenbosch in the excess of about $4 million (R40M). Only 25% of this amount was derived from state funded agencies, while 75% was derived from the private sector during a time of economic recession when academics complained that companies did not want to sponsor research. Since 2008 I raised in the excess of $500k (R2M) for research at two institutions on a casual basis.

During my time as Deputy Dean and Acting Dean I was the Chair of all the Research Centres of the Faculty of Engineering and Faculty of Science with a combined annual research budget of $15 – 20 million (R150 – R200M). As Chairman of Stellenbosch University Research Committee I was responsible for the effective allocation and distribution of research funds of about $10 million (R100M) per year at that institution.

Jul 1990 – Jun 1995 – Stellenbosch University, Department of Metallurgical Engineering, Stellenbosch, South Africa
Senior Lecturer and Associate Professor

I joined the Department of Metallurgical Engineering in July 1990 as senior lecturer. Initially my main task were undergraduate teaching, post graduate supervision as well as to complete my own PhD degree. The title of my dissertation was, "A fundamental study of the dissolution of gold from refractory ores" (supervised by Prof Jannie van Deventer). During that time I lectured the following subjects for undergraduate students, i.e. Thermodynamics, Mechanics of Fluids, Final Year Project, Final Year Plant Design, Electrochemical Engineering, Hydrometallurgy, Pyrometallurgy, Project Management; Technology Management, Innovation. I also acted as supervisor for masters and doctoral students during that time and the funding of the projects listed below (theirs and other consultation projects) were all industry funded projects (as indicated in brackets). I acted as the project leader for the following research projects during this time:

Hydrometallurgy (leaching)

- The simulation of a transient leaching circuit (Ni-Cu plant) – (Impala Platinum).
- The electrochemical dissolution of gold in bromide medium (Billiton -in those days Gencor).
- An evaluation of liberation models for the prediction of diagnostic leaching results (Anglo American).
- A fundamental study of the dissolution of gold from refractory ores (Anglo American/Anglo American Research Laboratories).
- The decomposition of refractory minerals in kimberlite ores (De Beers Research Laboratories).
- A fundamental study of the dissolution/decomposition of oxide and less refractory minerals from complex ores (De Beers).
- A report on the diagnostic leaching of samples supplied by Sastech R & D Division (Sasol Technology).

Mineral Processing

- Mathematical model for the thermal regeneration of spent activated carbon (Billiton -in those days Gencor).
- The adsorption of arsenic by activated carbon (Billiton -in those days Gencor).
- The dynamics of multi-component elution of metal cyanides from activated carbon (Billiton -in those days Gencor).
- Precipitation of jarosite in the ion exchange plant at Rössing Uranium Mine (Rössing Uranium Mine).

General

- The use of hollow-fibre carbon membranes in the catalytic conversion of cyclohexane (Sasol).
- The investigation into material failures of track pads (Rössing Uranium Mine, Namibia).
- The composition and optical quality of Grahamstown Kaolin (Batepro (Pty) Ltd).
- Calcination of Transhex Dolomite (Transhex (Pty) Ltd).

Oct 1988 to Jun 1990 - Somchem (Pty) Ltd (currently Denel), Somerset West, South Africa
Senior Engineer

I joined the aerospace industry in October 1988 as senior systems engineer. My main tasks during this short period were research, development and systems engineering of heavy calibre ammunition systems. As senior systems engineer my main task were to ensure that all components of a specific system being developed, are on track to be incorporated in the final product for testing and evaluation, thus a combination of systems engineering and engineering management. During that time I produced ten (10) research reports.

Aug 1987 to Sept 1988 - Anglo American Corporation - Freegold (Ops) Ltd, Pres. Brand Gold Mine, J.M.S. Uranium Plant, Welkom, South Africa
Senior Plant Metallurgist and Plant Production Superintendent

I moved to JMS Uranium Plant in August 1987 as Senior Plant Metallurgist and was promoted to Plant Production Superintendent in January 1988. My main duties as senior plant metallurgist were trouble shooting in the plant as well as assisting the plant management and plant personnel with technical help. My main duties as plant production superintendent were the management of 350 employees in a uranium plant producing uranium oxide. During that time I produced ten (10) research reports. During that time I worked on uranium leaching projects, solvent extraction projects as well as flotation project (the uranium plant used pyrite concentrate as feed material).

Jan 1983 – Jul 1987 – Anglo American Research Laboratories (currently Anglo Research), Johannesburg, South Africa
Research Metallurgist and Senior Research Metallurgist

I started working as a Research Metallurgist for Anglo American Research Laboratories (as an Anglo bursary holder) after completing my bachelor's degree in 1982. I was first seconded in 1983 to the Department of Metallurgical Engineering at the University of Stellenbosch where I conducted research into gold leaching for my master degree. The title of my thesis was, "The galvanic interactions during the electrochemical dissolution of gold".

After completing my experimental work in 1983 I had to do (at that stage) two years of military service in the South African Navy (Jan 1984- Dec 1985)

In January 1986 I started at the Research Laboratories again and worked on the following main projects during 1986 and first part of 1987.

- Commissioning of the pinned bed pilot plant (carbon in pulp).
- Development of a diagnostic leaching procedure for gold industry to identify the refractoriness in gold ores by the selective destruction of minerals. A patent was registered for the procedure during that time, i.e. Tumilty, J.A.J., Schmidt, C.G., Sweeney, A.G. & **Lorenzen, L.**, "Treatment of sulphidic materials", S.A. Patent No. 877790, Johannesburg, South Africa, 1987, 10 pages. This procedure is currently used worldwide in industry as an analytical tool. During the development of this procedure I spent many weeks on various gold plants as well as new ore deposits throughout South Africa as well as in Africa and South America.

I also produced twenty (20) published research reports during that time. I was promoted to Senior Research Metallurgist in January 1987. During 1987 I was asked to move to some of Anglo American's mines as part of my professional development programme within the group.

EDUCATION

Qualifications

PhD in Engineering	Stellenbosch University, South Africa, 1993
MEng (Metallurgical Engineering) *cum laude*	Stellenbosch University, South Africa, 1985
BEng (Chemical Engineering)	Stellenbosch University, South Africa, 1982
Post Graduate Diploma -	Executive Development Programme, Stellenbosch University, Business School, 1999
Graduate Company Directors Course	Australian Institute of Company Directors (2015)

COURSES

1983 to present - Various Personal Development Courses, Management Courses, In-house and External Courses by Anglo American, Stellenbosch University, BHP Billiton, Snowden/Downer Edi, Optiro, Lorenzen Consultants, etc.

EXTRAMURAL ACTIVITIES

Hobbies: Golf, Hockey, Touring and Camping, Gardening and volunteering.

REFERENCES

Available on request or see list in my complete CV.