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GENERAL
REGULARS



SAIEE



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This is the last issue of **wattnow** for 2017 - and what a year it was!

This year we've loved, lost, cried, laughed and learnt! Some doors have closed behind us and others have opened. We have gained knowledge and some of us had the fortune of aging!

Gosh, I really sound melancholic - but this is what this time of year does to me - reflecting!

I would like to make use of this opportunity to publicly thank my Technical Editors for their hard work, as well as every single one of the contributors and advertisers who supported this publication during 2017! Without your contribution and support, there would not be a **wattnow** magazine.

It's that time of year when festive lights are prevalent - we should rethink the energy saving option when we purchase our lights. Therefore, this issue features Lighting and we start off with the first feature article on LED Technologies that can be found on page 24.

The second feature article is on Street Lighting - discussing the challenges of surge protection, this begins on page 30.

The festive season sees people spending too much money on gifts and holidays, I thought it apt to feature an article on investing. Just think of it - you invest a bit of money on a monthly basis with the right investment company - you will have more spending in December 2018 to buy that yacht - or nice car - or island holiday!

Please take note that the SAIEE Head Office will be closed between 15 December and reopen on the 8th of January 2018.

I wish you all a fabulous festive season!

Until 2018 - Enjoy the read!



Visit www.saiee.org.za to answer the questions related to these articles to earn your CPD points.



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**JACOB MACHINJIKE
2017 SAIEE PRESIDENT**

We are near the end of the calendar year, and the festive mood is already with us. Most of us are looking forward to a good break from our normal schedules, and to spending quality time with friends and family.

May our rainbow nation shine on, and be a source of leadership light in the African Continent and the rest of the world!

I would like to take this opportunity to wish our Wattnow readers and contributors, SAIEE members and staff, partners and families “A happy festive season and prosperous 2018”. Most of us will decorate our homes and provide appropriate lighting that suits the period, as we wish “Compliments of the season” to one another.

Lighting is the theme of wattnow magazine for this issue. Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial light sources, such as lamps and light fixtures, as well as natural illumination from the sun, the moon and the stars.

Daylight is often used as the main source of light during daytime in buildings and vessels. This saves energy compared with using artificial lighting, which represents a major component of energy consumption in buildings.

Artificial lighting technology dates to tens and thousands of years ago, and has been refined over time to this present day. Around 1780 the oil lamp was widely used, and after that the gas lamp, which was followed by the arc lamp just after 1800. The next three development in lighting technologies were that of the bamboo filament, the fluorescent lamp and the Electric light bulb in 1875. The first city in the Southern Hemisphere to install electric street lighting was Kimberly in the early 1880s.

As we work together, we shall continue to make inventions that benefit society.

May our rainbow nation shine on, and be a source of leadership light over the African Continent and the rest of the world!

A handwritten signature in black ink, appearing to read 'J Machinjike'.

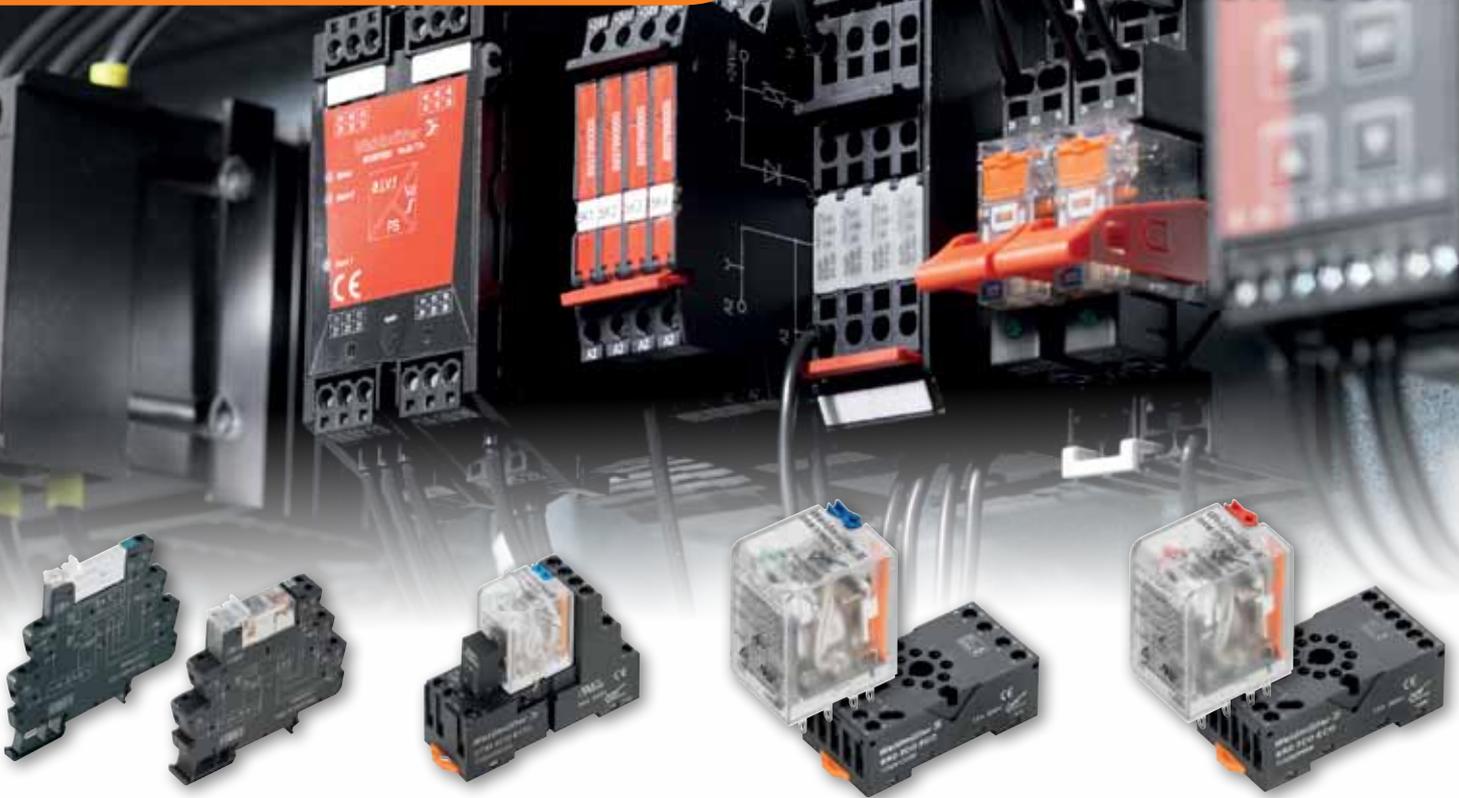
*J Machinjike | SAIEE President 2017
Pr. Eng | FSAIEE*



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WATTSUP

SAIEE 2017 Annual Award Winners



From left: Bernard Meyer (Powertech Transformers), Kgomotso Sethlapelo (2017 Young Achiever) and Jacob Machinjike (SAIEE President).



From left: Tembele Casa (Actom), George Debbo (2017 Engineer of the Year) and Jacob Machinjike (SAIEE President)

The South African Institute of Electrical Engineers (SAIEE) hosted its 106th Annual Banquet at the Wanderers Club in Illovo, Johannesburg on 27 October 2017.

Providing the evening's entertainment was the enigmatic Gavin Sharples, who had the guests in stitches, and literally had make-up running off faces of some of the female guests.

THE 2017 AWARD WINNERS ARE: ENGINEER OF THE YEAR AWARD

This award, sponsored by Actom, was jointly awarded to Lebo Maphumulo and George Debbo.

Lebo Maphumulo, an SAIEE Member since 2008, studied Electrical Engineering in Malaysia and obtained her degree in 2004. She works for Eskom as a Corporate

Specialist: Power Lines since March 2017. She has written 5 technical papers for the Engineering Industry to date.

George Debbo has been a SAIEE Member since 1975, and has served within the Telecommunications Industry for over 30 years. He has occupied executive positions within Telkom SA, Marconi South Africa and Ericsson. He is currently



From left: Francesco Pagin (Fluke), Amelia Mtsali (2017 Engineering Excellence Award winner) and Jacob Machinjike (SAIEE President).



From left: Francesco Pagin (Fluke), John Gosling (2017 Engineering Excellence Award winner) and Jacob Machinjike (SAIEE President).

an independent consultant specialising in Software Defined Networking (SDN) and Network Function Virtualisation (NFV).

ENGINEERING EXCELLENCE AWARD

This prestigious award, sponsored by Fluke, recognises current major contributions in any sector of electrical, electronic, telecommunications and computer engineering in South Africa. This award is jointly shared by Amelia Mtsali and John Gosling.

Amelia Mtsali, an SAIEE member since 2004, is actively involved in the SAIEE Central Gauteng Centre activities. She is a qualified Engineering Technologist and received her National Diploma in Electrical Engineering in 2000. She is involved in various SAIEE committees.

John Gosling has been a SAIEE member since 1966 and has been actively involved in engineering ever since. John has served on the SAIEE Council since 1993, won the Engineer of the Year Award in 1995, served as the SAIEE President in 2001, and was awarded the National Science Award in 2003. John is currently heading up in the successful implementation of SAIEE's mentorship, and has chaired various committees.

SAIEE PRESIDENT'S AWARD

Andries Tshabalala is 2017's recipient. He graduated with a BSc.Eng (Elec) in 1983 from the University of Natal (UKZN) specialising in Electrical machines. Andries has served on the SAIEE Council since 2006, and was elected SAIEE President in 2011. Andries participated in the formation of City Power in terms of the City's Igoli2002 plan; he is currently the Deputy Chairman of Actom.

KEITH PLOWDEN YOUNG ACHIEVER'S AWARD

This award, sponsored by Powertech Transformers, recognises young achievers up to 35 years of age, who have made meaningful contributions to the engineering industry. This year, the recipient, Kgomotso Sethlapelo, an SAIEE Member since 2012, received



From left: Andries Tsabalala (SAIEE President's Award winner) and Jacob Machinjike (SAIEE President).



From left: Albert Lysko (IEEE SA), Sy Gourrah (SAIEE), Saurabh Sinha (2017 Distinguished Volunteer Award winner) and Jacob Machinjike (SAIEE President).



WATTSUP

SAIEE 2017 Annual Award Winners cont.

this honour. Kgomotso is involved with SAIEE's Central Gauteng Centre. One of his significant contributions to the centre, was the compilation of the Centre's operating model where he ensured it aligns to the SAIEE Constitution and Bylaws. Setlapelo volunteered to lead the Corporate Social Investment initiatives of the Gauteng Centre. He has recently been promoted to Chief Engineer: Power Delivery Engineering, Protection, Telecommunications, Metering and Control section in Eskom, making him one of the youngest Chief Engineers to date.

SAIEE / IEEE JOINT DISTINGUISHED VOLUNTEER AWARD

This award was established in 2013 and promotes the spirit of volunteerism by recognizing a volunteer active in the IEEE, SAIEE or both organizations. The award criteria require that the volunteer should make or have made a valuable contribution to the electrical engineering profession in South Africa, and promote the electrical/electronic engineering profession in South Africa within IEEE/SAIEE designated fields, as well as meaningfully contributing to one of the social challenges in South Africa through the application of electrical/electronic engineering.

The 2017 recipient of this award is Prof Saurabh Sinha, who is the Executive Dean of the Faculty of Engineering and the Built Environment at the University of Johannesburg. As of 1 December 2017, he will serve as the Deputy Vice Chancellor for the University.

The SAIEE congratulate all this year's winners and are immensely proud of these individual achievements.





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World Robotics Olympiad



Township 2017 teams

For the 6th consecutive year, the South African leg of the WRO (World Robot Olympiad) was again successfully held in 2017 with amazing growth of Robotics participation around the country. There was a massive uptake of LEGO Mindstorms Robotics at school level. This is due to more inclusion of Robotics during school time as part of technology and IOT from primary school level which is very encouraging. In general, there is recognition that Robotics and coding are essential in education from a STEMI and “hands on” perspective.

Three main provincial competitions Gauteng, Western Cape and KwaZulu Natal were held in August plus the very popular Atteridgeville Township event where 200 Gr 6 learners from surrounding primary schools received training at 5 centers for 30 weeks of the year.

In 2016 there were 283 teams of 2 - 3 learners that participated nationally; of these 60 teams qualified for the WRO National event. 13 national winning teams qualified and represented South Africa at the International WRO event in Delhi India in November. Of these, 6 teams were positioned in the top 20 in the world with the WRO Football Team earning a well-deserved 5th place.

In 2017 again, there was substantial growth in participation at schools, privately and some teams from a SAASTA/ ASTEMI (Association for STEMI Olympiads and competitions) initiative where there is funding offered to take these opportunities to rural and under - serviced schools and areas.

The National WRO had entries from 377 teams across the country of which 93 were

hosted at the WRO SA National event at TUT Tshwane University of Technology. 11 teams qualified and were invited to the international WRO event in Costa Rica.

As there is no sponsorship only 9 teams managed to gather the funds to go ahead to participate in San Jose CR.

The delegation, who left for Costa Rica, consists of 22 learners, 9 coaches, 3 parents and 16 volunteer referees and judges.

The teams are listed on www.wrosa.co.za and the 2017 events and the updated information is well publicized on Facebook : wro South Africa

It has been an exciting year again and we look forward to the uptake of inter school competitions at entry level and the new challenges from Thailand for 2018.



Sebenza – biggest substation in SA

Nearing its final months of completion, the Sebenza 400/275/88kV substation constructed and project managed by Consolidated Power Projects (CONCO) for City Power, will be the biggest substation to be built in South Africa in the past ten years. It will also be one of the main intake substations in the north eastern region of Johannesburg making it one of the country's hubs that is set to stimulate much needed economic growth. It has been built with expansion in mind and is intended to increase in capacity from 315 MVA to 1000 MVA. This will dramatically improve reliability and stability of the grid.

CONCO's senior project manager, Thami Nyembe, says, "We planned this project in three phases: phase one encompassed design/engineering, land development and civils with a massive 40 000m³ being allocated for the earthworks and 1 700m³ for concrete with over 200 foundation structures built; phase two was machinery procurement and delivery including erecting of equipment; and phase three which we are currently busy with, entails the connecting

and commissioning of the equipment and energizing of the substation. Basically, we are on track and expect initial energizing of the substation to take place in early December this year. This milestone is also dependent on ESKOM completing their work at Prospect Substation and energizing the lines to Kelvin at 275 kV (presently energized at 88kV).

"Depending on City Power's ability to give us "shutdowns" without affecting consumers unnecessarily, we would be able to start swinging certain circuits from Kelvin Substation into the new Sebenza GIS switchboard. There is a total of 18 circuits to be swung over and due to certain constraints this will only be completed during the first quarter of 2018. However as soon as we start swinging circuits, this will start relieving the load off the aged Kelvin power station and Prospect substation plus enabling City Power to begin reaping benefit from the increased capacity".

Part of the Sebenza project involved CONCO having to upgrade and make additions to both Prospect and Kelvin substations which included installing four sets of reactors and new switchgear on some of the main feeders at Kelvin. Two of

the Kelvin bays have been completed with the balance only becoming available once the Sebenza substation is energized.

The three enormous 3 x 315 MVA 276/88/22 kV power transformers are in the process of being delivered and tested on site. Unit one is complete and ready for commissioning, with unit two currently being installed. Unit three is expected on site by the first week of October and should be ready for commissioning by the end of October.

Getting these transformers to site is a major operation, whereby a 114 wheel truck is necessary to carry merely one transformer. Installing them is also a delicate process as they weigh in the region of 100+ tons each.

The impressive three-story GIS building houses the latest technology equipment.

"Due to the sheer magnitude of this project, management of it is significantly challenging hence the need for meticulous project management and continuous support from our consultants PSW, City Power personnel, CONCO's site-based management and our sub-contractors," expressed Nyembe.

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Shell Eco-marathon South Africa 2017



Launched locally in 2014, and proudly hosted by the University of Johannesburg's School of Electrical Engineering, the 2017 Shell Eco-marathon recently took place at the Zwartkops Raceway just outside Pretoria. The competition brings student teams from across the African continent to compete in the ultimate energy-efficiency challenge.

The Shell Eco-marathon challenges student teams around the world to design, build and drive the most energy-efficient cars. This year saw teams from South Africa and Nigeria take to the track to battle for ultimate energy efficiency.

Shell Eco-marathon South Africa is a great opportunity: For inexperienced teams to practice and improve their vehicle in order to get selected for Shell Eco-marathon Europe 2018. For newcomers to present and test their project and above all experience the unique Shell Eco-marathon spirit with fellow competitors on a professional circuit.

For experienced teams to fine tune their vehicles and strive to improve their personal bests.



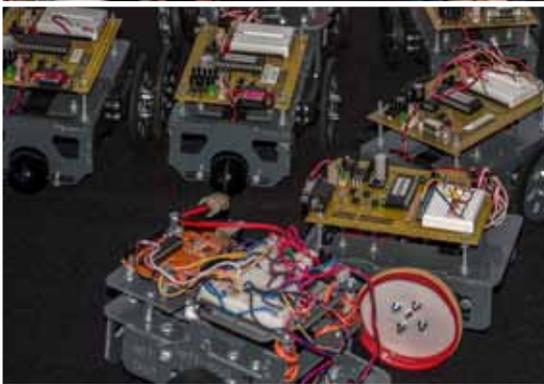
The Nigerian Team from Ahmadu Bello University.

From left: Philip Josiah, Mukhtar Yau, Waizik David and Auwal Dayyabu



A future Eco driver?

Learners race their DIY robots at UJ AfrikaBOT challenge



On Sunday 22 October 2017, teams from township and private schools raced the robots they built through a maze at the second AfrikaBOT competition at the Zwartkops International Raceway near Centurion. AfrikaBOT is a robotics challenge hosted by the University of Johannesburg's Faculty of Engineering and the Built Environment (FEBE) Technolab.

Approximately 40 Gauteng junior high and senior high school teams competed in separate categories and 20 teams of university student teams competed in the undergraduate categories. There was also a category for "makers" which includes graduated engineers and even "moms" and "pops" with a technical inclination looking for a chance to showcase their talents.

"The competition is an ideal opportunity for young people to get a taste for careers in advanced technology and engineering," says AfrikaBOT organiser, Mr Michael Ettershank, from UJ Technolab.

Ettershank facilitates the robotics classes that form part of the UJ Technolab community outreach programme in Alexandra Township and Diepsloot.

"Because the teenagers build their robots themselves, the cost of their AfrikaBOT robots is a fraction of typically imported robots that are used in global competitions," adds Ettershank. *"There is no compromise in quality however. The robots are world class and could hold their own in overseas competitions. The AfrikaBOT 2 is built around Arduino, an open source hardware platform, and programmed in C++. The C family of programming languages is the world standard in robotics, mechatronics and industrial automation,"* adds Ettershank.

The AfrikaBOT 2017 challenge was that the robots had to drive autonomously through a maze without wireless control, which introduces learners to the types of challenges faced by engineers at Google with their self-driving car.

This year, a record of 56 teams participated in this competition, but there could only be one winner in each of the categories. The winners of the 2017 AfrikaBot Competition are:

Junior High Category (Grade 8 & 9)
Ameera Essop of Team Robot R2D2, which hails from Metropolitan Academy - walked away as winner.

In the Senior High Category, which caters for Grades 10 - 12, the winners are Daniel Buchholtz, Carmiel Mahood and Marco Moller from Team Sparky, hails from Maranatha Christian School.

The Undergraduate Category saw Parallax1 with Brandon Ormond from University of Johannesburg walking away with the trophy.

In the Inventor Category, which is open to all ages, had Gert van der Walt and Flavius Mareka from TVET College, Sasolburg winning this category.

The winning Innovator of the day was Temitope Ogunsanwo from Woodhill College.

The SAIEE congratulates all participants and organisers for making this a memorable day. Well done to the winners.

Watch this space for the 2018 AfrikaBot Competition and Shell Eco-marathon!

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2017 National Student's Project Competition



The 2017 SAIEE National Student Competition participants are:

From left: Willem Jonker (CUT), Joshua Piggott (UKZN), Rushil Daya (Wits), Shamiso Mukuchira (NMMU), Dr Leigh Jarvis (Host - UKZN), Lyzane Aiken (CPUT), Zola Ntsahngase (Chairman, KZN Centre), Caylin Nell (UP), Kiuran Naidoo (UCT), Michael Dukes (Wits), WP Swart (NWU), Ryan Johnstone (UJ) and Helgard La Grange Oosthuizen (Stellenbosch University).



The judges with the Executive Team, from left: Vikesh Punwassi, Xolani Banda, Zola Ntsanghasi (Chairman, KZN Centre), Syabonga Langa, Dr Lee Jarvis (Host - UKZN), Ellen Shezi and Stan Bridgens (CEO, SAIEE).

The Howard College Campus at the University of KwaZulu-Natal (UKZN) played host to the 2017 SAIEE National Student's Project Competition.

The Immediate Past President, Mr TC Madikane, welcomed all the guests and said: *"The SAIEE has been hosting this competition for twenty years and the standard of the submitted projects has increased dramatically".* He added *"All of you who have entered this competition are already a winner and we thank you."*

The 2017 Judges, who had the unenviable task of deciding the winners, were: Vikesh Punwassi, Siyabonga Langa, Xolani Banda and Ellen Shezi.

Cape Town walked away with both category wins! The 2017 National Student's Project Competition winner, in the BSc Category, is Kiuran Naidoo from the University of Cape Town, for his project titled *"Classifying and Identifying recyclable materials on a conveyer belt system"*.

The B'Tech category winner Lyzane Aiken hails from the Cape Peninsula University of Technology for her project *"Real time simulation of the implementation of an out of step generator dropping scheme"*.

The participants in this year's competition is:

- Michael Dukes and Rushil Daya, Wits
- Ryan Johnstone, UJ
- Joshua Piggott, UKZN
- WP Swart, NWU
- Willem Jonker, CUT
- Kiuran Naidoo, UCT
- Caylin Nell, UP
- Helgard Oosthuizen, Stellenbosch
- Shamiso Mukuchira, NMMU
- Lyzane Aiken, CPUT.

We thank our sponsors Fluke and PPS for their involvement and valued sponsorship.

We also thank the students for taking the time out of their busy schedules to participate in this competition.

SAIEE Power Section visited the ABB plant - written by Derek Woodburn PrEng, FSAIEE



Fourteen of the SAIEE Power Section members visited the ABB Longmeadow offices and plant on 8 November 2018.

Access to the area included an alcohol breathalyser test at the security gate, and the requirement for wearing safety shoes, or at least closed-toe shoes.

One is not conscious, when driving past the business estate, of just how big the huge ABB structure of the centralised offices and production site is, until you access it. The visiting group was given presentations on the Power Quality Systems of ABB, their Micro-Grid Systems, and then on their Traction Transformers, together with factory visits.

A video showing the roof-mounted solar panels, fitted on the enormous building,

(taken using a Drone), made one sit up and take notice of the level of sophistication we were about to experience!

The fascinating presentations on the ABB Power Quality and Power Grid expertise, applied to their own structure, and in industry in general.

The group was also taken on two factory tours within the business estate. The first showed how their Power Quality and Micro-Grid systems are designed, produced, and used in operating in maintaining power continuity, and quality commercially, as well as for their plant and offices. We were able to see how they have produced, and are working in, the most efficient electrical system in the world to date. The high percentage of local content, manufacture and training was impressive.

After a delicious lunch, the group was given another detailed presentation on their Traction Transformer project and manufacturing facility. The writer had been heavily involved in the manufacture of large static Power Transformers about 40 years ago. The great differences in design and quality involved, affecting the power quality, where this product is pressed, vibrated, shaken and accelerated, was stunning. The group then moved to a second manufacturing site, still within the Longmeadow Business Estate. There we were able to observe the processes and tight tolerances critical for the final assembly of the Traction Transformers (that drive the new generation of electric freight engines).

Throughout the visit, the talented presenters clearly answered many detailed questions from the SAIEE Power Section group.

CIGRE Hosted Biennial International Conference

The Southern African National Committee of CIGRE, CIGRE SANC, hosted their biennial international conference at the Lord Charles Hotel, during November 2017, under the theme “Electricity Supply to Africa and Developing Economies: Challenges & Opportunities”.

CIGRE is a 96-year old international organization of 9 100 individual members and 1 100 collective members worldwide,

headquartered in Paris, France. It was set up to advance the sharing of technical knowledge on large electric power systems.

The Conference comprised of working group meetings, 8 technical tutorials on various topics on the 14th, a technical paper program that saw 80 papers presented in 7 sessions, exhibitions and two technical site visits on Friday the 17th.



One of the tutorials, sponsored by the World Bank, is a Masterclass on the design of overhead power lines. The World Bank is looking to improve skills for the efficient design of electrification infrastructure in developing countries.

WATTSUP

IITPSA names 2017 Award winners at prestigious 60th Year Celebration



IITPSA 2017 Award winners

From left: Alec Joannou, Wayne, Sashi Hansjee and Prof Pete Janse van Vuuren

Titans of the industry gathered for the Diamond Awards Banquet in Sandton recently to celebrate 60 years of South African ICT excellence and congratulate the winners of the prestigious IITPSA awards.

The IT Personality of the Year Award 2017, presented by the IITPSA in association with ITWeb, the Gordon Institute of Business Science and Gartner South Africa, recognises a person who has had an outstanding impact on the SA ICT industry over the past year. The accolade went to Shashi Hansjee, CEO of Entelect, who has helped drive significant growth in profit and the company's move to a Deloitte 'Best Company to Work For'.

The Visionary CIO Award is presented by IITPSA in association with ITWeb, the Gordon Institute of Business Science, and Gartner South Africa to an executive in the corporate IT environment who has demonstrated visionary leadership in

applying technology to grow and transform business. The 2017 winner, Sasol CIO Alec Joannou, leads a team of 400 permanent staff and over 600 contractors serving over 30 000 users across four continents; as well as serving as a trusted advisor to a number of boards including Unilever, Sappi, Anglo American and Sasol.

In addition to the Visionary CIO and IT Personality of the Year Awards, the IITPSA, in partnership with EngineerIT, presented its Distinguished Service in ICT Award recognising a significant, career-length contribution to the ICT industry, to Prof. Pete Janse van Vuuren, Director of The Thinking Cap; and the 2017 Fellowship was awarded to the chairman of the IITPSA Innovation Special Interest Group, Wayne Mallinson.

IITPSA President Ulandi Exner noted that the IITPSA, founded in 1957 as the Computer Society of South Africa, was the third-oldest computer society in the world

and its IT Personality of the Year Awards has been running for 39 years.

"We have grown from about 7,000 members to around 9,000 in the past year – an indication that people are recognising that professionalism in this country, especially in ICT, is very important." She added that IITPSA reaches out to tens of thousands of children annually through its programmes, and had this year introduced a comprehensive bursary. In future, IITPSA aimed to step up its Women in ICT programmes to close the 80-20 gap still evident in the industry, said Exner.

Thanking supporters and sponsors Altron and Huawei, Tony Parry, Executive Director and CEO of IITPSA, said that past winners, representatives of the Australian Computer Society, and long-standing IITPSA members including industry veteran Joan Joffe, who has been an IITPSA member since the late 1950's, were among the guests at the prestigious awards and anniversary celebrations.

Mteto Nyati, Group Chief Executive of platinum sponsor Altron and himself a former winner of the IT Personality of the Year award, highlighted the importance of choices in life. *"We all make choices, but in the end the choices make us,"* he said. *"This applies to individuals, companies and countries. Look at a country like Singapore, which in 1964 was at the same level as Ghana, and is now at number three in the world in terms of GDP – thanks to the choices it made. We all have a responsibility to make the tough choices and the right choices to take our country back to what it was meant to be. 60 years ago IITPSA was formed, now it grows year after year, and we as individuals and companies have to make*



the choices of how we support the institutions like this, which are so key to the development of this country.”

Other finalists for the IT Personality of the Year Award 2017 were:

- Annette Muller, founder of on-demand workforce platform Flexy and DotNXT
- Baratang Miya, founder of GirlHype Coders Academy
- Karen Nadasen, CEO of PayU South Africa
- Mixo Ngoveni, founder of Geekulcha
- Nico Steyn, co-founder and CEO of IoT.nxt
- Reshaad Sha, CEO of SqwidNet
- Yvone Thobile Mabuza, founder and managing member of Elangeni Consulting Services
- Jaco Maass, Senior Manager: ICT at BKB

Other finalists for the Visionary CIO Award award were:

- Michèle Hall, Nampak Management Services CIO
- Peter Rix, Barclays CTO & Head Infrastructure Services
- Sello Mmakau, Airports Company South Africa CIO
- Mthoko Mncwabe, SA Post Office Group CIO
- Joe Phago, National Treasury CIO
- Shalin Naidoo, Lenmed Health Group CIO
- Mothusi Lukhele, Sanlam Personal Finance CIO



From left: Tony Parry (CEO, IITPSA), Ulandi Exner (President, IITPSA) and Moira de Roche (Honorary Treasurer, IITPSA).



WATTSUP

CESA appoints President



CESA President, Neres Pather

At the Consulting Engineers South Africa's (CESA) 64th Annual General Meeting, held at the CESA Seminar in Johannesburg in November, Neres Pather from Mott MacDonald Africa was inaugurated as President of the organisation for the next two years. He succeeded Lynne Pretorius. Sugan Pillay, Managing Director of Zitholele Consulting was elected to serve as Deputy President of CESA for the same period.

Pather, a Statutory Director of Mott MacDonald Africa, currently heads up the Transportation Sector in their Africa Business Unit. He holds a BSc. Engineering (Civil) degree and a MSc. Engineering degree in Transportation and as such has led many transport and strategic infrastructure projects within the company.

He has more than 24 years' experience in the industry. Prior to joining Mott MacDonald, Pather was the "CEO of PD Naidoo & Associates Consulting Engineers (Pty) Ltd" for a period of 12 years. He joined the company in 1997 and held a number of positions in the capacity of Director before becoming the CEO.

Approved Miniature Circuit Breakers on the market



A full range of approved miniature circuit breakers, offering protection against overload and short circuit in electric conductors, is available from Zest WEG Group.

A full range of approved miniature circuit breakers, offering protection against overload and short circuit in electric conductors, is available from Zest WEG Group.

The WEG MDW and WEG MDWH miniature circuit-breaker line comply with the tripping characteristic curves B and C, according to standards IEC 60898 and IEC 60947-2.

These miniature circuit breakers have been developed to be used in low voltage

circuits with direct or alternating current from 2 to 125 A and short circuit breaking capacity up to 10 kA. The full range includes all accessories in both 5 kA and 10 kA, making it possible for the Zest WEG Group to supply customers with complete solutions for specific projects.

All the WEG MDW and WEG MDWH miniature circuit breakers can be used in both commercial and domestic applications.

Effective Maintenance made easy

Even as cost cutting eats into maintenance budgets, companies can avoid catastrophic failures if they adopt the structured approach offered by specialists like Marthinusen & Coutts. "If all stakeholders understand and support the importance of a structured maintenance programme, then the next step is to agree on the most critical equipment in the client's facility," says Craig Smorenburg, Marthinusen & Coutts. "These assets are the ones that must be most closely managed, as they impact directly on the whole operation's success and sustainability."

A further study is then conducted to ascertain which elements within each item are critical to maintain, and how the OEM maintenance guidelines must be applied. "We then develop a strategic level-based maintenance plan, which considers all maintenance requirements and activities," he says.

"We generally advise clients to conduct their weekly or monthly maintenance activities in-house, otherwise they lose touch with their equipment and lose the necessary skill."

DEHNrecord Alert makes the maintenance of SPDs smart and simple

DEHNrecord Alert enables status reports from surge protection devices (SPDs) to be transmitted via Modbus and, for example, relayed to a smart device. The start-up is quick and easy via the free app, which allows you to receive status reports, such as push messages, wherever you are, reporting if all the devices are working and, if not, which ones need replacing - without having to physically examine the equipment. Available from lightning and surge protection expert, DEHN Africa, the DEHNrecord Alert module makes for quick and easy SPD maintenance.

DEHNrecord Alert (DRC MCM AL XT) can manage status reports from four universally applicable remote signalling contacts and up to 150 SPDs, including the DEHN BLITZDUCTOR XT surge arrester.

Up to four surge arresters from the Red/Line range, or from other arbitrary functional modules with remote signalling contacts, can be monitored by way of remote signalling contacts. DEHNrecord Alert sends status reports on surge protective devices via Modbus TCP or Modbus RTU to an evaluation system and enables transmission to devices like notebooks, tablets, smartphones and PCs or to the system control room.

DEHNrecord Alert is quick and easy to start up with the help of an app. The app relays device information, for example, part numbers and type designations to DEHNrecord Alert. By sending this data to the user's evaluation device, the user is provided with all the information required in the event of a fault to quickly procure and replace the faulty module. DEHNrecord Alert facilitates the efficient and cost-effective co-ordination and conduct of service and maintenance work. The standard way of communicating the status of the device is via Modbus TCP/RTU, however should different bus protocols be needed, DEHN will meet requirements.

Power underpins wave of African industrialisation

Power is closely tied to a surge of new infrastructure projects and rapid industrialisation across Africa, with significant opportunities still open to the power sector, delegates heard at a briefing for key power sector stakeholders in Sandton recently.

Infrastructure spend across Africa will grow at 10% per annum from 2015 to 2025, exceeding \$180 billion by 2025. Much of this is expected in Nigeria and South Africa with Nigerian infrastructure spend topping \$77 billion by 2025, while in South Africa infrastructure spend may reach \$60 billion by 2025. Strong development is also forecast in Ethiopia, Ghana, Kenya, Mozambique and Tanzania.

This is according to Duncan Bonnett, Director Strategy & Business Development at Africa House, research partner to POWER-GEN & DistribuTECH Africa, who was addressing power sector stakeholders in Sandton in the lead-up to POWER-GEN & DistribuTECH Africa 2018.

Outlining the importance of energy for Africa's development, as well as some of the opportunities for the power sector, Bonnett said: *"This infrastructure development is unlocking growth in basic manufacturing in sectors such as chemicals, metals and fuels, which in turn drives growth in spend on utilities."*

Transport accounts for just over \$200 billion in projects across Africa - largely in rail, ports and road, followed by power with around \$150 billion of projects in the system - not including Grand Inga, which is unlikely to be realised in the foreseeable future. 17% of the power projects are by South Africa, followed by 12% in Nigeria. It's a very exciting space to be in at the moment."

Power development across Africa goes beyond the 'mega power projects', he said. *"It also extends to consumer solutions and modular solutions."*

Bonnett noted that with adequate power, economies and industries saw immediate benefits, while a lack of power exacerbated problems.

"For example, 50% of Tanzania's crops rot because there are no cold storage facilities, which is due to inadequate power. Power is such an underlying aspect of development that spans just about every sector and every opportunity. In parts of Zambia, the roads are in a poor condition not because of trucks carrying copper and cobalt doing the damage; but because of the trucks carrying diesel to the mines. The introduction of proper power to those mines would actually go a long way to solving the roads problems in Zambia."

In the Democratic Republic of Congo (DRC), he noted, as little of 400MW of power would enable mines to double their output.

Particularly strong development was taking place throughout Africa's 'energy belt', he said. *"Across the region we are seeing strong infrastructure-led growth."* However, Bonnett noted that there were factors that had to be taken into consideration by stakeholders seeking to benefit from the wave of growth and development: *"We find a lot of South African companies have misconceptions about the region and what's driving it."*

Bonnett warned that investors had to be cognizant of the growing importance of local content and preferential procurement across Africa. *"You'll have to have local content, a local office and skills transfer,"* he said. *"You've got to be in situ if you want to be part of the game."*

OBITUARY - RONALD (RON) G. HARLEY



PROF RONALD G. HARLEY
1940 - 2017

Professor Ronald Harley joined the SAIEE in 1960.

A Fellow Member of The South African Institute of Electrical Engineers (SAIEE) for 57 years!

Known by so many of our older members particularly those who studied and graduated at the University of Natal.

SAIEE President Mr Jacob Machinjike, the SAIEE Council and staff proffer their sincere condolences to Linda Harley and family while paying tribute to the tremendous contribution Ron Harley has made to the electrical engineering fraternity in South Africa and abroad.

Prof Harley grew up in South Africa where he attended the University of Pretoria and completed his BScEng and MScEng degrees in 1960 and 1965 respectively.

He worked for the South African Railways and the University of Pretoria. He continued his graduate studies at Imperial College in London where he was awarded a PhD from the University of London in 1969.

He was appointed to the Chair of Electrical Machines and Power Systems at the University of Natal in Durban, South Africa, in 1971. In 1983 he became the Head of the Department of Electrical Engineering and in 1995 the Deputy Dean of Engineering at the University of Natal.

He was a visiting professor to Iowa State University, to Clemson University and to Georgia Institute of Technology in 1975, 1985 and 1994 respectively. He went to Georgia Tech in February 1999 as the Duke Power Company Distinguished Professor. Dr. Harley was appointed as a Regents' Professor by Georgia Tech President G.P. "Bud" Peterson in August 2009.

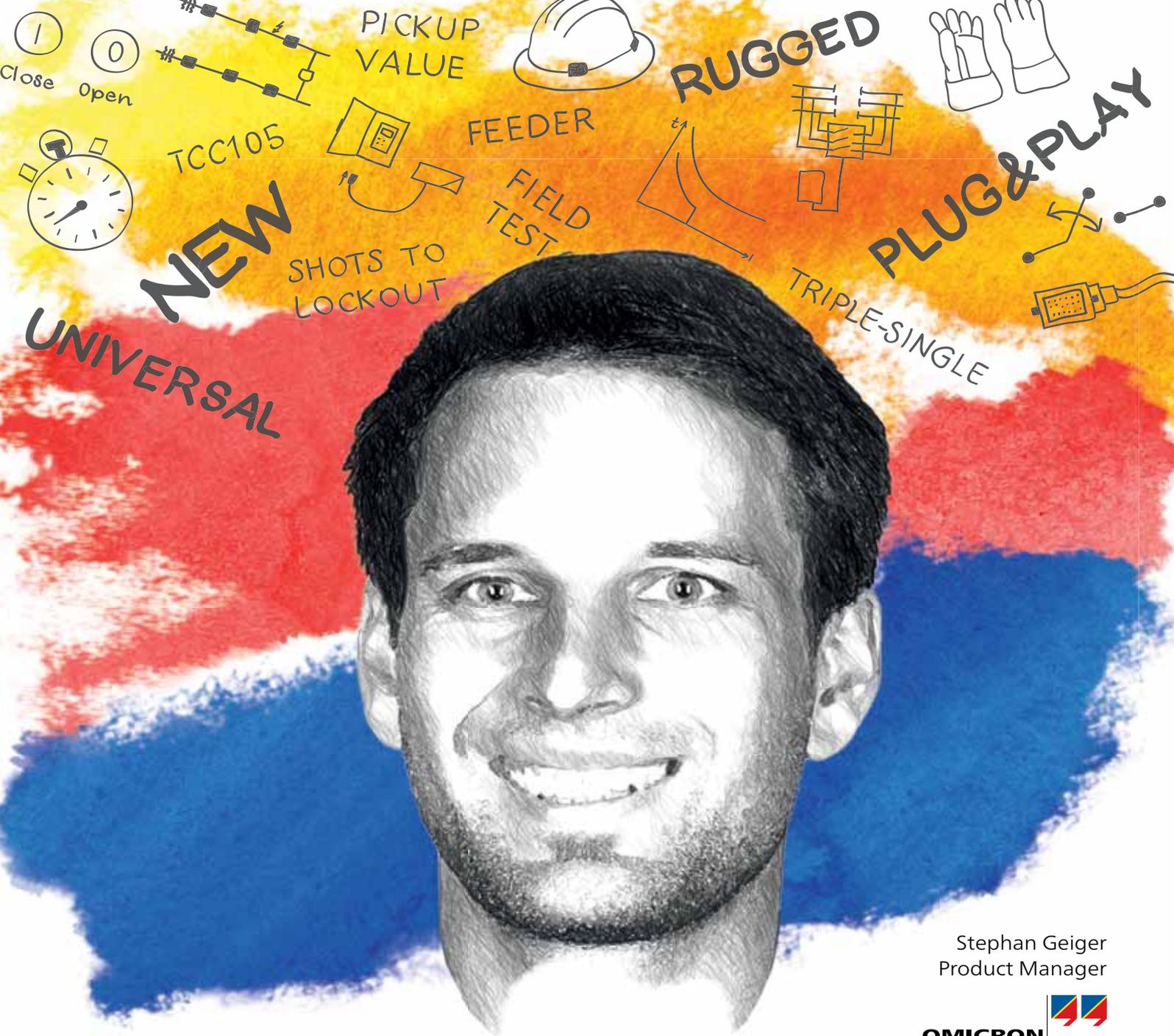
He has published more than 220 papers in his field, he was the co-author of a historical text book on Electrical Machines. He received numerous awards and distinctions from professional societies. His loved the guitar and woodworking as hobbies.

RESEARCH INTERESTS:

- Power system stability and control, including Flexible AC Systems (FACTS) devices;
- Power electronics, motor drives and electric vehicles;
- Neural networks applied to power electronics and electrical machines.

DISTINCTIONS:

- Fellow of the IEEE.
- Fellow of the British IEE.
- Fellow of the SAIEE, and Fellow of the Royal Society in South Africa.
- Member of the Academy of Science in South Africa.
- Elected Vice-President (Operations) of the IEEE Power Electronics Society in January 2003.
- Elected as one of six Distinguished Lecturers of the IEEE Industry Applications Society 2000-2001.
- Vice-Chair of IEEE Industry Applications Society's Distinguished Lectures and Regional Speakers Program Committee since January 2000, and Chair of this committee since January 2003.
- Invited member of a 6-person panel who reviewed Advances and Trends in Power Electronics and Drives in the IEEE Industrial Electronics Society's 25th Annual Conference (IECON99) in San Jose, Nov 1999. He presented the section on Artificial Intelligence Techniques in the Control of Power Electronics and Motor Drives.
- 1999 Best Paper Award by the International Joint Conference on Neural Networks. In 2001, he again received a Best Paper award at the same conference.
- General Co-Chair of the 2003 IEEE Symposium on Diagnostics in Electric Machines and Drives (SDEMPED), to held in Atlanta. **wn**



Stephan Geiger
Product Manager



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At first this technology was used for signaling and indicator lighting, it has radically changed, becoming today's "light of the future". LEDs have innovative and advanced technical features, as well as a very small physical size, which allow the products to be inserted into any light fitting.

LEDs are therefore the most effective alternative to traditional lamps (incandescent, fluorescent, and halogen).

LED technology

BY | SCOTT WILLIAMSON

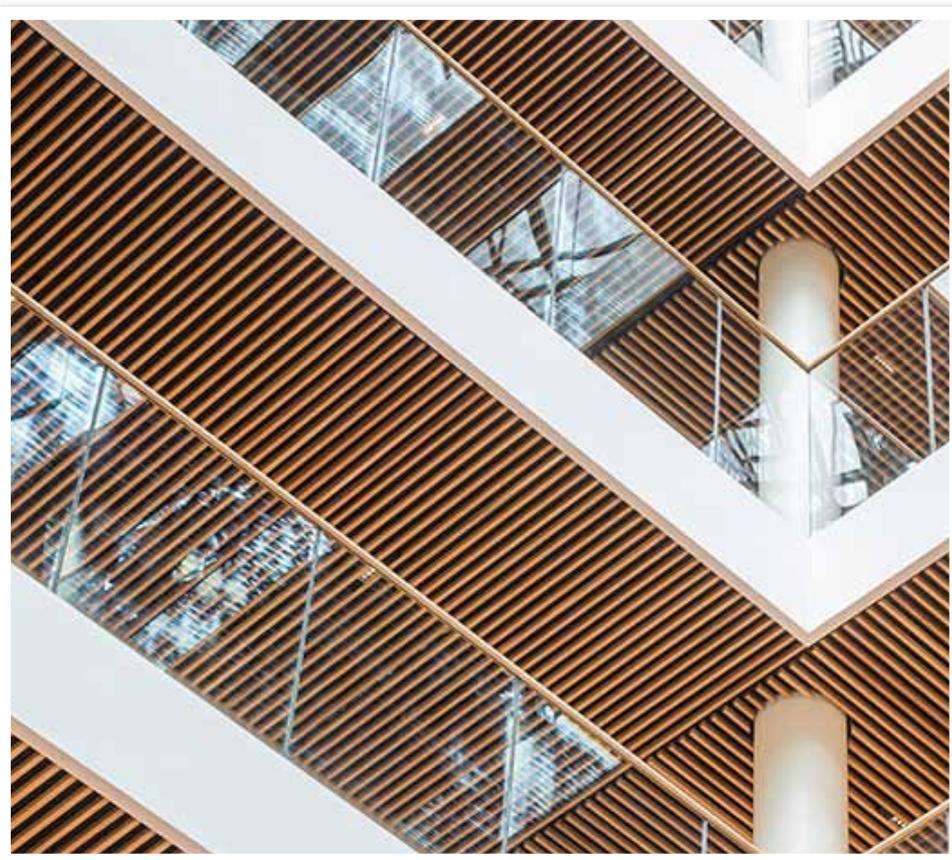
The LED is a very recent light source: the first red LED was developed only in 1962, but we had to wait until 1969 for the first commercial red LED available.

In 1979, the discovery of a high-efficiency blue LED by Shuji Nakamura, whose brilliant blue light paved the way to white LED lighting, went into production in 1993.

LED “light emitting diodes” are small devices, emitting light thanks to properties of semiconductor materials. Since they have neither filaments nor gas inside them, they are called solid state devices. When the LEDs are powered with electrical current, the free electrons and the gaps are combined again, releasing sufficient energy to produce photons. Due to the reduced thickness of the chip, part of the photons can exit it and be emitted as light.

Designing with LEDs means studying new geometries, as well as innovative relational strategies between the technological elements of the lighting fixtures. It is complex work based on integrated systems and requires unique competence and thorough know-how.

The well-known Italian-based company iGuzzini, relies on over half a century of experience, when fulfilling its mission to design fine quality LED devices. It source the most accredited and specialized raw material suppliers, as well as LED and lamp manufacturers. It runs tests throughout the work processes, applies the most advanced nanotechnologies – in diffusion schemes, for example – and combined design and technological innovation with the aim of achieving quality, safety, reliability and enduring performance.



ENEC, UL and CCC markings ensure the compliance with the strict standards in terms of electrical safety and electromagnetic compatibility.

This provides a further guarantee for clients' projects. iGuzzini is the lighting manufacturer with the highest number of ENEC (European Norms Electrical Certification) certificates.

LEDS LUMINAIRES ARE NOT ALL THE SAME

A good LED does not necessarily guarantee a good luminaire, since it is the entire system that determines the quality of the product: the optic system, the LED module, the dissipation system and the driver of power supply.

The skills required come from a range of fields: electrical, mechanical, thermal and physical.

When selecting an LED product therefore, it is important to assess the quality of all the components and the guarantee supplied by the manufacturer.

LEDS PROS:

LED EFFICACY: The LEDs are known for their small dimensions with high efficacy, reaching up to 150 lm/W, enhancing the design possibilities in terms of creativity, and progress, in other words, creating high intensity solutions. Hence High efficacy results in energy savings, and therefore a cost reduction. Designing with LEDs means studying new geometries and innovative technologies, leading to a world without limits.

LIFE SPAN: The LED lifespan exceeds all the life expectancies of conventional lamps, reaching 90 000 hours of operation. This also results in maintenance savings and hence a further reduction of costs. The mechanical parts are designed in detail to guarantee long life and correct heat dissipation.

COLOR CONSISTENCY: This is the value that describes the variation in chromaticity among a batch of supposedly identical LED samples. iGuzzini's technologies guarantee the emission of the light flux at the beginning of the life cycle, as well as

LED Technology

continues from page 25

a stable CCT (colour consistency) for its entire operating life for all LEDs installed in each unit, and among all fittings with the same CCT.

MACADAM SELECTION: selecting the LED is important, since no two LEDs will ever be identical. The MacAdam step guarantees that an LED falls within a certain colour temperature range. The MacAdam steps go from 1 to 6, where the lower the number is, the closer will be the colour of the LED to the LED reference colour.

CRI: Pushing the boundaries of lighting, LEDs offer a high color rendering index, which indicates the ability of light sources to reproduce the colors of the objects, faithfully in comparison with an ideal light source "Sun". In order to compare the color rendering properties of each light source objectively, the standard measurement method of the CIE operates on a scale from 0 to 100 (from poor to excellent).

OPTICS

More advanced technology, less light dispersion and higher energy savings.

One of the most challenging problems of LEDs is caused by the fact that the emission of the chip passes through the phosphor, along different thicknesses at different angles, so the white light varies slightly in colour temperature. The Opti Beam technology solves the problem, giving a better chromatic uniformity, and an even light effect, with no double ring.

OPTI BEAM LENS: the high intensity super spot optic is ultra compact. The light beam is even and well defined, with no colour aberrations. Maximum visual comfort is guaranteed by a spill-ring inside



Palco Mano

the lens. One great example is offered by Palco Low Voltage.

Palco Low Voltage has been designed by ARTEC3 Studio. In their own words, "The shape is inspired by a paintbrush, the artist's main tool and part of the creative process. Just as the paintbrush symbolizes the physical act of creating the work, in our fixture the paintbrush also inspires its shape". The company's intention with Palco Low Voltage is to extend the Palco collection of spotlights and framers in the micro dimension, by developing solutions with 51 mm, 35 mm and 19 mm diameters powered at low voltage. Opti Beam optical technology generates a well-defined beam without double-ring effects. This ensures extraordinary visual comfort. Spotlights with spot, medium and flood spreads, and multiple cones are available. In addition, Wall Washers are available for excellent vertical distribution, and framers to create bright geometrical forms, with sharp and precise outlines. Up to two accessories can be fitted simultaneously to adapt and

direct the light beam. Dual adjustment, with tilting by $\pm 90^\circ$ and rotation up to 355° . Installation on track, individually or in groups, with optimized centres and rods for wall mounting. The ideal applications for these fittings is in museums, retail, hospitality & living sectors.

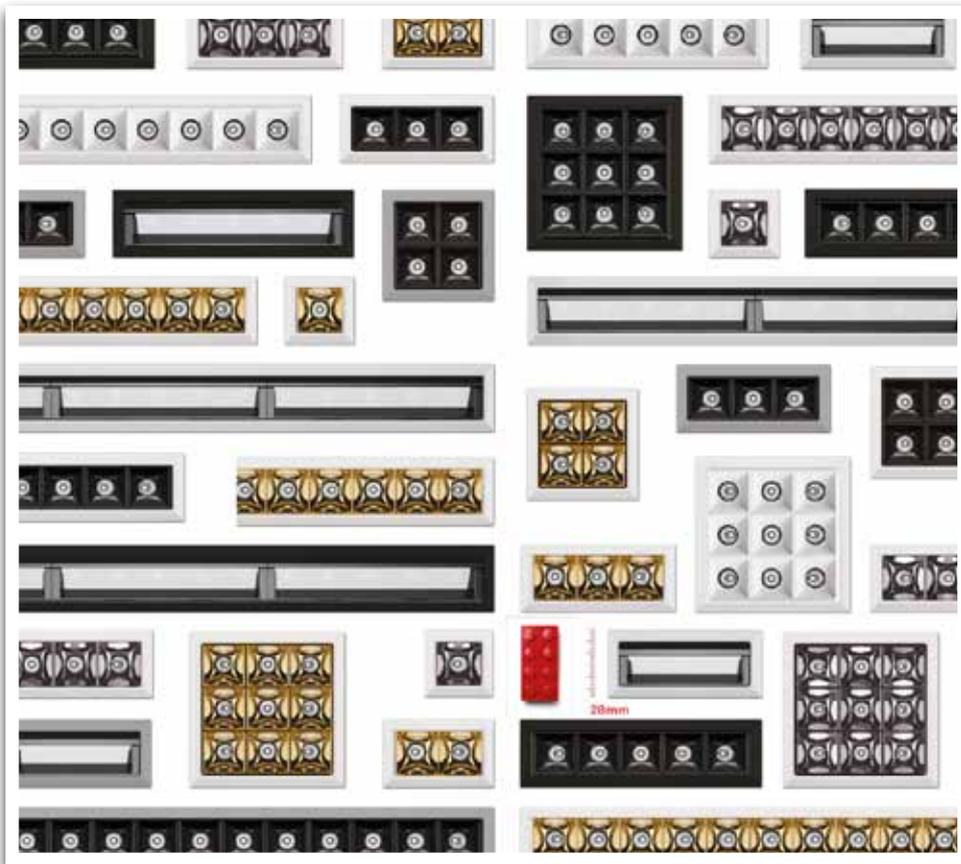
OPTI BEAM REFRACTOR: micro-prismatic textures with random modelling symmetrical elements that avoid any kind of geometric and chromatic aberration. When combined with the Opti Beam Lens, refractors model the beam of light using different apertures. If we examine the Laser Blade XS, for example, we can understand the advantages of this technology better.

Laser Blade XS is an innovation icon, and it is the smallest linear downlight system. The form is miniaturized, but not the performances. The light source is invisible, thereby ensuring total visual comfort, with values of $UGR < 10$. Light is directed and maximized by a micro optical bench which uses the patented Opti Beam technology: the special texture of this (multi-faceted) optic amplifies the reflections of light rays emitted by the LED, to create a clean final effect, free of chromatic imperfections. Laser Blade XS High Contrast with Opti Beam emits a perfectly defined and uniform light beam. The Wall Washer version has an exclusive combination of reflectors and optical screens that ensure uniform and even illumination of vertical walls. Detailed technologies studies underlie a screen comprising an oblique internal reflective part (that directs light towards the upper edge of the wall) and a reflective prismatic surface at the front. Also available with Tunable White technology. Clean aesthetics and geometrical compositions: Laser Blade XS is offered as square combination, as well



Keeping up with ultimate fibre solution

Around the world, demand for faster residential and commercial broadband communication solutions is increasing. The Ditch Witch® MT12 MicroTrencher, which provides the fastest, most efficient way to install high-speed fibre-optic cable underground. Slicing through asphalt and concrete with remarkable speed and precision, the MT12 is the high-tech solution to our increasingly high-tech world—and the most cost-effective solution for fibre-installation contractors.



Laser Blade XS

as the linear one. Ideal applications for this iconic luminaire are in Retail, Hospitality & Living Sectors. Minimal, as thin as a blade. Laser Blade cuts ceilings to liberate light.

Opti Smart is the technology that we apply to urban lighting, where efficiency and comfort are the drivers in developing increasingly innovative solutions.

The Opti Smart Reflector provides visual comfort and efficacy for our outdoor products. A combination of optical control of intensities and luminaire efficacy, at the same time providing a lower light pollution, and reducing CO₂ emissions.

Wow, for example, is an intelligent urban lighting system with the latest technology:

electronics that adapt to the diverse needs of a project, and to different working settings, available with different optics and delivering a fast payback. Sustainability, energy savings, careful use of resources, these are the keywords when building a smart city, improving the quality and safety of urban streets, while also achieving economic savings.

A complete system from 18 to 168W, Wow is available in three different sizes. Installation as a single, double or triple pole-top, or with single or double arms. The body can also be installed at the mid-point of the pole. The wall-mounted version completes the options. Exclusive and intelligent electronics, studied and designed by a leading Innovation Lab, allows Wow to adapt to the requirements of each project, and different operating needs.



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LED Technology

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Standard features include step dimming with profiles, compatibility with the most commonly used tele-management systems, constant lumen output and allows for the possibility for future upgrade. Streetware is a revolutionary software developed to assist light planners and technicians in the choice of the right product, based on the specific project needs.

The optimal solution is presented through a report with data of energy savings, and real consumption through the entire product time. The combination of Wow's optics and electronics guarantee high energy savings together with significant cost reductions.

Precise light, distributed efficiently on the road, with no light pollution. Wow is designed to avoid replacing the LED module and the power supply for the entire product lifetime. Significant savings of maintenance costs compared with traditional fittings. Less cleaning required as well. A microprocessor constantly controls the atmospheric temperature and automatically acts on the product's current being drawn to guarantee that vital parameters are respected.

Unique is its kind, with an IP67 rating, Wow is resistant to water and humidity infiltration, potentially damaging for any device with electronics. The optical block can be replaced at the end of its life with an up-to-date technology. Even the rectangular LED optic modules can be easily replaced on products already installed.

Opti Smart Lens: "Tailor-made" lenses modelled with free-form technology to define shapes and forms perfectly and exploit light flow to the full. A great example is Quid, designed by Enzo Eusebi.

Quid's sleek design is inspired by the desire to strip off anything that is superfluous and focus on the essence of the product. The distribution of its geometrical volumes is carefully designed to underline the luminaire's high-tech character, and a formal contrast of curves and straight lines gives it a rational, balanced harmony.

Quid is an LED street light that meets a wide range of present and future requirements, from a simple on-off mechanism to DALI management, which is the key means of access to potential "smart-city" integration. Immediate energy savings of over 65% can be expected even by just replacing existing lamps (such as high-pressure sodium or mercury lamps).

Quid is also eco-design, so at the end of its life, it can easily be broken down into its recyclable parts. Each town has different requirements, each street has its own needs. Quid responds to any set of requirements. The various electronic devices control the luminous flux according to the usability of urban areas.

This allows the light to be adapted to town rhythms with significant energy savings. From simple on-off control to Dali dimming, from automatic profiling to voltage-based flux regulation, and dual-operation: everything is possible. Quid is also open to tele-management.

Safety and simplicity: the disconnection switch and opening clip are designed with that installation in mind. Quid amplifies integration for the town with light and movement sensors, as well as wifi signal. Quid is both technologically versatile and energy conscious. Strength is at the core of Quid. It is designed for reliability, and

precise tests carried out in laboratories have certified it. IP67 rating certifies the fixture is waterproof: it is resistant to dust and water penetration, which is fundamental to guaranteeing performance.

Heat dissipation: Thanks to thermos and fluid-dynamic simulations, we are able to define the best geometry for our products in order to maintain a constant LED operating temperature.

LOW MAINTENANCE

Efficiency: Lighting device efficiency is based on the ratio between the light flow emitted and the electrical power used, and this is obtained by combining various elements, such as an intelligent and innovative optic design.

Low power consumption: Saving Energy is an issue that requires attention and dedication.

As a testament to energy savings, "-CO₂ ReLighting" was born. This project's objective is light quality by using less energy, and therefore less CO₂ emissions.

Fittings and lighting systems were designed that uses technology to contain the amount of energy that is used, and therefore reduces pollution.

High efficiency lamps, high yield optics and electronic components that can connect networks with control systems in order to manage fittings. We can thus reduce energy requirements by using electricity in adequate quantities, and only when it is truly needed.



INSTANTANEOUS SWITCH-ON COST

New frontiers of lighting design – Vertical excellence: Vertical lighting is a masterpiece. Light entirely overlaps the surface of the wall. Ensuring delicacy.

Total cleanliness from bottom to top, with maximum uniformity, without edging effects. Architectural and visual perception changes, emphasizing verticality and the identification of the objects exhibited. This solution also assures impressive flexibility, avoiding the need to adapt the system every time the exhibit on the wall is changed.

Vertical illumination of interiors not only modifies the atmosphere inside a building but can also characterize the view from the outside by expanding and highlighting specific night-time perception. Uniform illumination of external facades highlights their material nature with discretion, without imposing nuances of shadow areas that might otherwise alter architectural details.

Miniaturization: The technological innovation offered by latest-generation LEDs, together with research into materials, optics and applications, have enabled us to use every precious millimeter and eliminate superfluous space.

Devices measured with fingers, sophisticated technological jewels: chromatic quality, huge range of optics, clean light beams and visual comfort. High-contrast and vertical lighting. Minimal and essential light, merging with architecture or integrating in display cases and show windows.

Ideal application in retail, culture, hospitality & living spheres. Miniaturization of dimensions, not performances: sophisticated optical systems achieve extraordinary lighting design results.

The LED Technologies are not only related to products but has a big impact and major role in the application in space.

The market of LED luminaires evolves rapidly and represents the present and near future of lighting.

In relation to the value generated the estimate for 2020 indicates 20% for traditional and 80% for LED luminaires. Further opportunities will come from OLEDs which have complimentary properties that will sit alongside LEDs in future lighting systems.

Working with LEDs offers many challenges, to ensure performance and reliability over time. Technical teams develop new optical technologies to achieve comfort and precision, in indoor and outdoor architectural lighting. The result is pure innovation. **wn**

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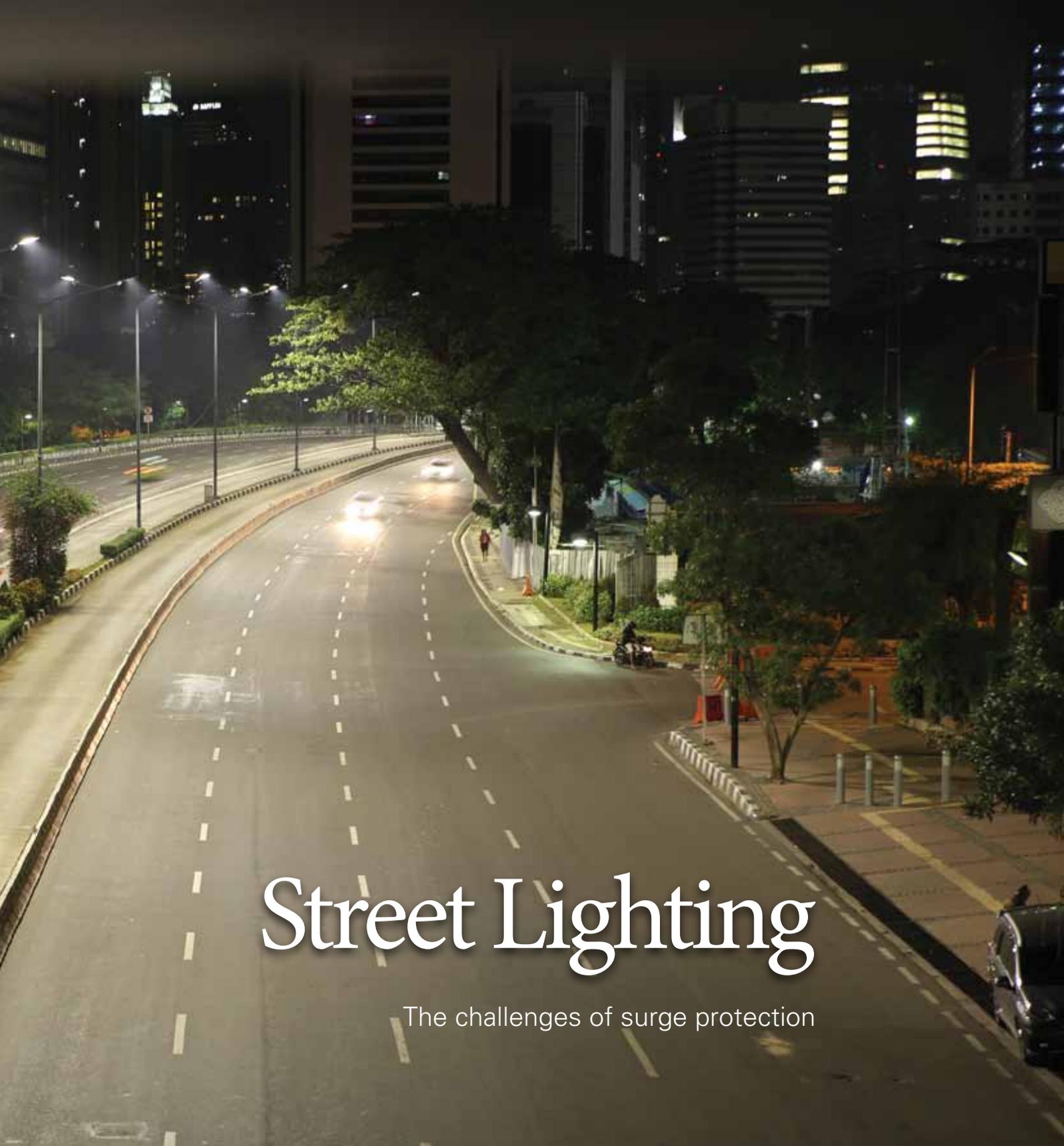


Voltage surges have a huge destructive impact upon public lighting systems. They wear out LED drivers and distribution panels prematurely, and increase service interruptions to street lighting. Beyond material damage to the luminaires, voltage surges caused by lightning, for example, can trigger or break protective devices in the circuit boards of street lighting distribution panels. So as well as the cost of replacing hardware, the public is left without lighting — a critical safety issue in the case of pedestrian and traffic tunnels, road signs and other public lighting.



The vulnerability of electronic lighting systems to overvoltages is widely recognized in technical literature, and different European regulations and standards specify the need for lighting protection. This white paper explains the causes of lighting

overvoltages and how they affect public lighting installations. It also covers the legal and regulatory framework governing protection, and proposes a solution to maximize protection performance and continuity of service.



Street Lighting

The challenges of surge protection

Public lighting installations are exposed to the environment. Located where continuity of service is essential, it is crucial that these installations are protected against lightning and overvoltages.

Investing a small amount in protection can extend luminaire lifetime, improve public services and greatly reduce overall operating and infrastructure costs.

BUILDING-IN PROTECTION

What are transient or surge overvoltages? When analyzing the phenomenon of overvoltages, we consider surge overvoltages and power-frequency

Street Lighting

continues from page 31



Fig.1 Transient "surge" overvoltage

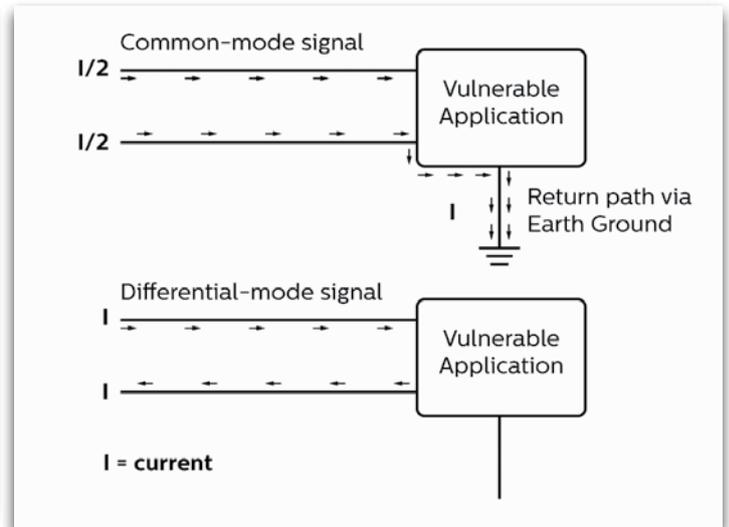


Fig.2 Definition of common and differential-mode currents

overvoltages separately. Although they both represent an increase in voltage above an acceptable limit, their root causes, magnitude, duration and method of protection are radically different.

Surge overvoltages are spikes that can reach tens of kilovolts but last for only a few microseconds. Despite their short duration, their high energy content may cause serious problems to equipment connected to the electricity network - from premature aging to destruction - resulting in service disruptions and costly repairs.

Voltage surges have several causes. For example, lightning discharges that directly strike the distribution line of a building, or its lightning rod, can induce electromagnetic fields that generate voltage spikes in nearby lighting installations.

And very long outdoor distribution power lines are highly susceptible to the direct effects of lightning strikes, with large currents from the lightning being conducted in the power lines. It's also

common for non-weather phenomena to cause voltage spikes in adjacent lines - for instance, switching inside transformer cabinets, or the disconnection of motors and other inductive loads.

Surge overvoltages have two modes of circulation: common and differential. Common-mode overvoltages appear between the live conductors and earth: for example, line-to-earth or neutral-to-earth. Differential-mode overvoltages circulate between live conductors: line-to-line or line-to-neutral. A well-protected luminaire should integrate protection for both modes.

Surge overvoltage protection is provided by installing a protective device (surge arrester) on the vulnerable line, and connecting it in parallel or in series.

When connected in series, the protection device acts as a fuse. But when it's connected in parallel, the luminaire continues to function even after the Surge Protection Device (SPD) is damaged. The SPD will get damaged after weathering a number of

spikes above a certain voltage level. In the event of a surge overvoltage, the protective device will divert excess energy to earth, thus limiting the peak voltage to a tolerable level for the electrical equipment connected downstream.

An SPD acts as a voltage-controlled switch. When the network voltage is lower than the activation voltage, the component is passive. On the other hand, when the network voltage exceeds the activation voltage, the SPD diverts the surge energy and prevents it from destroying the equipment. When choosing an SPD, you need to consider the equipment's exposure to the effects of lightning, along with the maximum impulse voltage that the equipment needs to withstand.

In general, the most effective approach to protect large installations of lighting equipment against surge overvoltages is by cascading multiple protective stages. Each stage combines the necessary balance between discharge capacity and voltage protection level. This way, a first stage

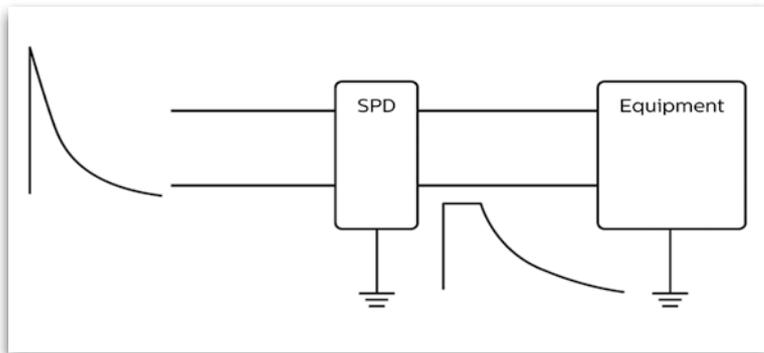


Fig.3 Working principle of a surge protection device (SPD)

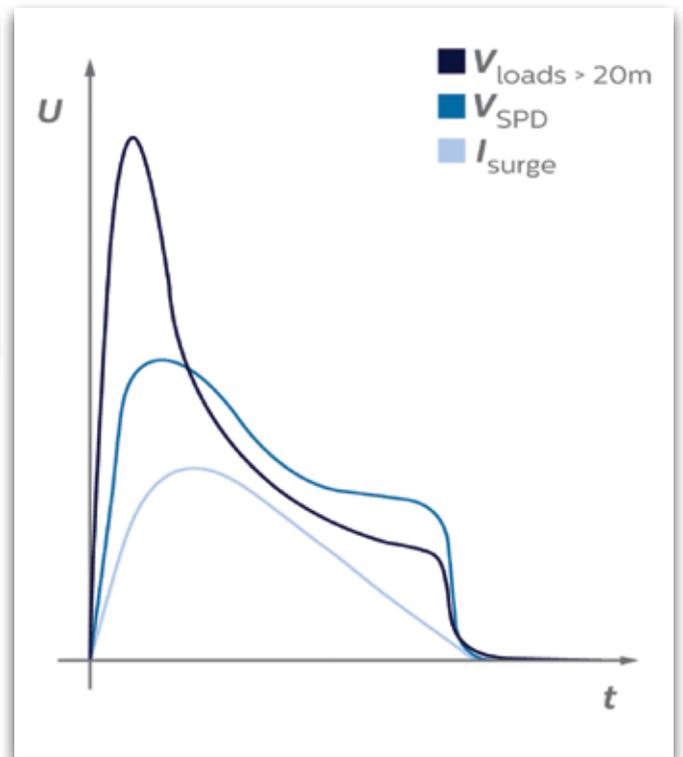


Fig.4 Effect of cable distance on the voltage protection level

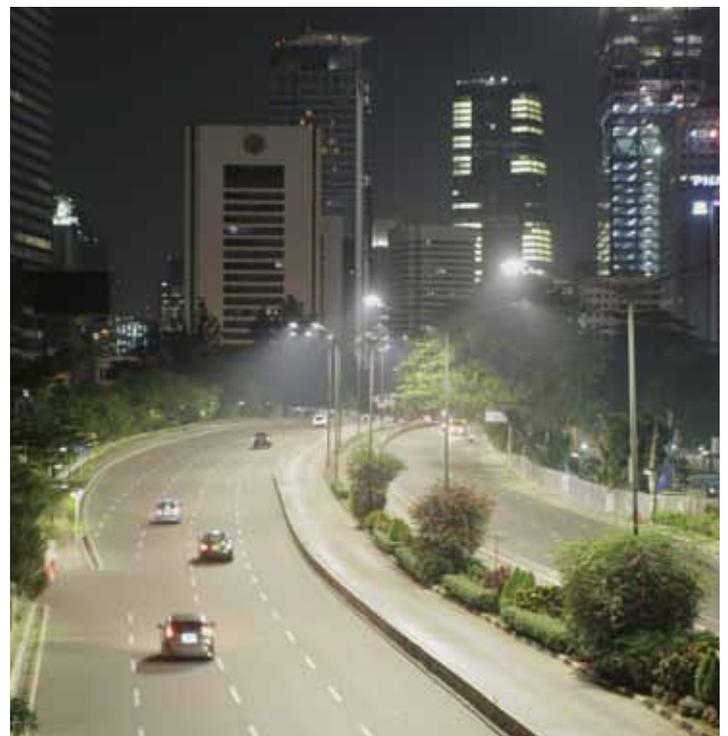
(typically a ‘Type 1’ or ‘Type 2’ SPD) provides robustness, thus diverting most of a spike’s energy, while a second stage (typically a ‘Type 2’ or ‘Type 3’ SPD) provides ‘fine’ protection. Thus the peak voltage reaching the equipment always stays below the critical level.

Of the causes of surges mentioned in international protection standards, the ones most likely to affect a public lighting system are:

- direct lightning strikes on distribution lines (conducted through the power lines); and
- lightning strikes near to a building/structure (creating induced surges).

European standards EN 60.364-5-534 and EN 62.305-1 require that protection against these types of electrical disturbance are to be provided by a Type 2 SPD. The protection solution is installed downstream of the main circuit breaker in the distribution panel circuit board, in parallel to the main system. So it diverts the energy of the surge to earth, limiting the voltage peak to a tolerable level for equipment connected downstream.

To guarantee proper protection of a luminaire, the distance between it and its protector circuit must be as short as possible. If the distance between a protected distribution panel and several luminaires is more than 20 meters, using a second protection stage (of Type 2 or 3) is recommended, even if the protection level of the first stage seems to be sufficient (see Fig.4). **wn**



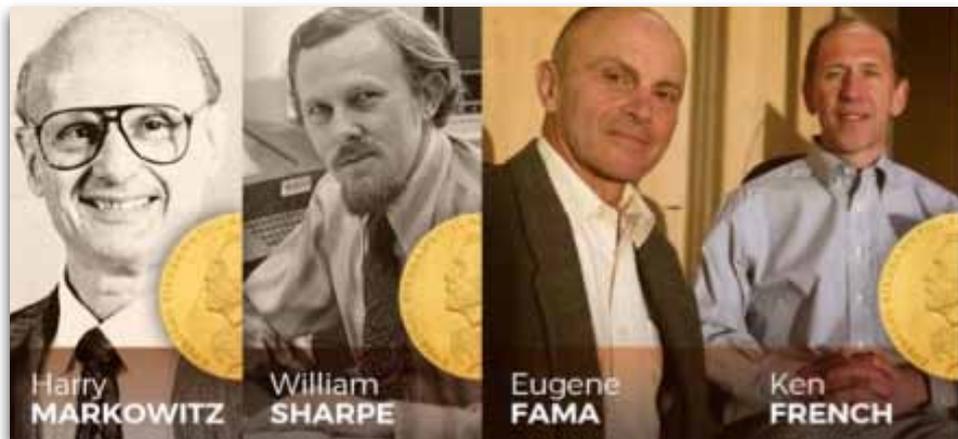


Smart Beta Investing for Engineers

WATT
NOW

The engineering approach to problem solving is again proving its robustness. There is a disruption currently happening in the investment management industry and it is being driven by the engineering approach. Smart Beta or Factor Investing, is quite simply the natural evolution of the application of data, technology and the scientific method to analyse the stock market.

BY I RADEMEYER VERMAAK & RYAN JAMIESON



On the shoulders of giants

Technology is a major disruptor in every industry imaginable, and the investment industry is certainly not immune. Smart Beta is logical and understandable, and as a result is leading to the 'industrialisation' of the investment management industry. This article aims to explain the foundation of this investment approach.

ON THE SHOULDERS OF GIANTS

Smart Beta strategies are rooted in academia and the work of three Nobel Prize winning authors. The research-orientated Smart Beta philosophy is grounded on the seminal work done by Harry Markowitz (1952), William Sharpe (1964) and Eugene Fama and Kenneth French (1993).

Applying these fundamental and economical principles to terabytes of global data using vast processing power, Smart Beta has highlighted that there are

certain characteristics of stocks that drive a large part of the stock markets return. These characteristics (factors or Betas), are intuitive and understandable, and the same aspects you would consider when you're buying a car or a house, such as value, quality and risk.

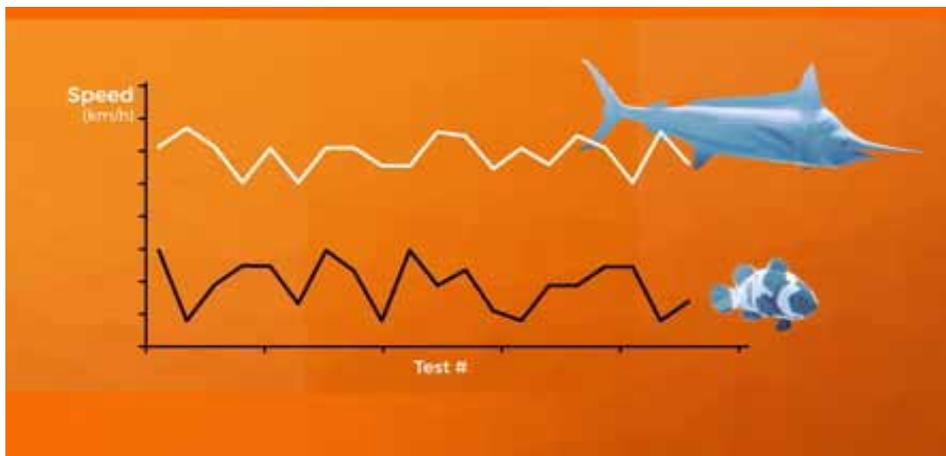
AN EXAMPLE

How would one apply the scientific method to determine these characteristics? An analogy is often quite useful, and a simple starting point would be to test the hypothetical hypothesis that within a given shoal of fish, the length of a fish is a characteristic that affects its speed. There are of course other characteristics that might affect the speed of a fish, such as its individual genetics, but for now we will focus on length. A simple test is to divide the shoal of fish into two buckets, those of above average length (long), and those of



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below average length (short), and sending them off to the races.

We can perform a number of tests, calculating the average speed per bucket over subsequent 100m dashes. Plotting the average speed of each bucket over time, we can ascertain that the length of a fish is a characteristic or factor that affects its speed.

Adding granularity, we might convert this to a simple linear equation.

$$Speed_{fish} = \beta * Length_{fish} + OtherFactors$$

In statistics, the gradient is often called the Beta – and that is thus the origin of the name “Smart Beta”.

Applying the exact same approach to the financial markets, we can divide a “shoal”

of stocks, such as the TOP40, into two buckets (above average and below average), by any given characteristic. An example of such a characteristic that is often used is the price earnings (P/E) ratio. The P/E ratio is a measure of how cheap or expensive a stock is - also known as the value of a stock. (A direct comparison of the value ratio in the real estate market is the Price/Rental income ratio, where a house with a higher price per unit of rent is considered more expensive.)

Dividing the TOP40 stocks into above average P/E (expensive) and below average P/E (cheap), we again perform a number of tests, calculating the average return per bucket over subsequent 1 month dashes. Plotting the average return of each bucket

over time, we can ascertain that the P/E ratio of a stock is indeed a characteristic or factor that affects its return.

If we convert this to a simple linear equation, it would look as follows:

$$r_{Stock} = \beta * P/E_{Stock} + OtherFactors$$

Thus, a portion of the return of a stock can be explained due to its value characteristics (its P/E ratio).

It does of course get slightly more complex, but these are the foundations of multi-factor return models.

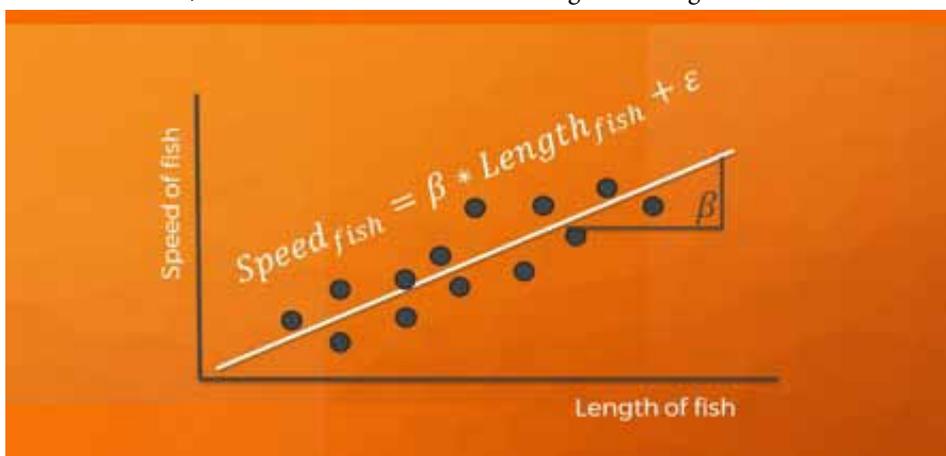
A NEW BENCHMARK

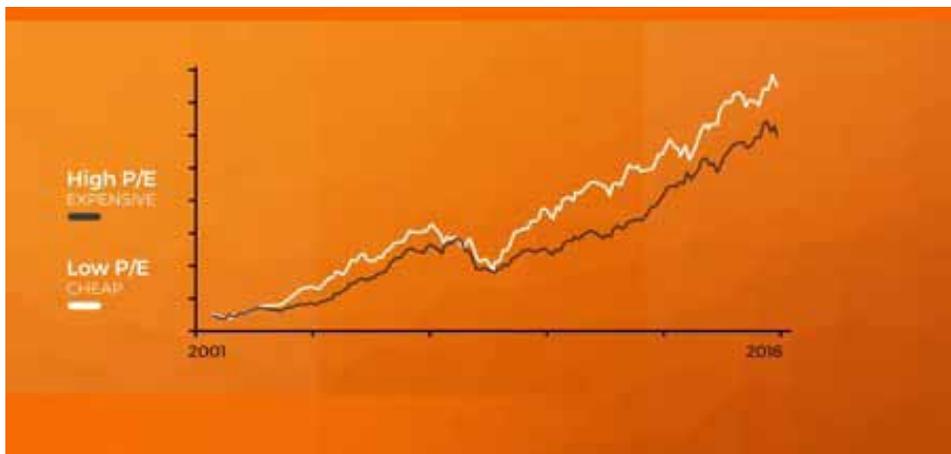
Smart Beta funds ‘package’ these characteristics or factors in an investment portfolio at a fraction of the cost of traditional active management fees. Please do keep in mind that the strategy embraces the same fundamental information that active managers make use of.

It’s becoming more widely accepted that Smart Beta is the new benchmark for traditional (active) fund managers. The new benchmark for true investment skill will be in the ability to consistently beat Smart Beta solutions. Smart Beta is clinical and emotionless and is able to handle vast amounts of information efficiently and at low cost to construct ‘informed passive’ solutions.

FUNDAMENTALLY INSPIRED, SYSTEMATICALLY APPLIED

The growing popularity of low-cost, passive investment strategies, along with mounting pressure on traditional active managers to outperform indices and benchmarks, reinforces the fact that investors are more receptive than ever to considering





alternative investment strategies in pursuit of investment outcomes.

Smart Beta strategies are positioned between pure, passive low-cost index funds and traditional, more expensive active management. Smart Beta strategies are rules-based and consistent in terms of philosophy and process, which means that the investment strategy is systematic and repeatable.

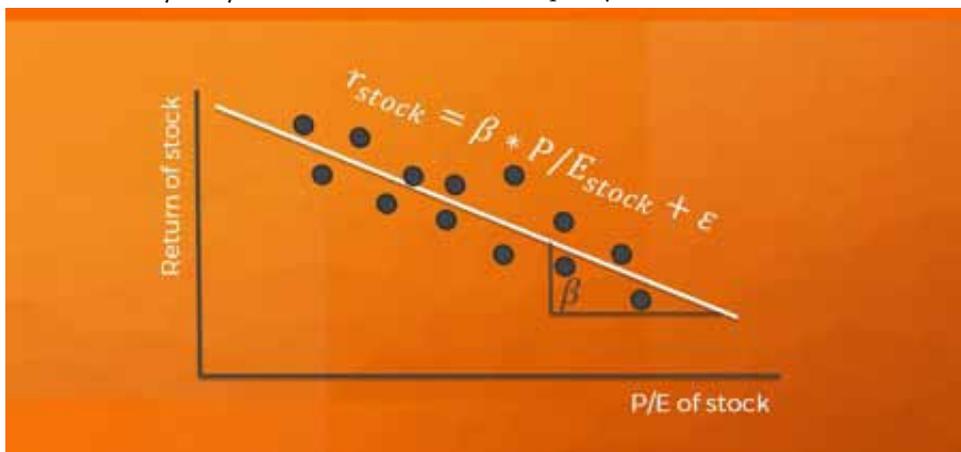
It is important to note that Smart Beta strategies are completely transparent and are not a 'black box' approach to investment management. Advancements in computer science and technology allow for large amounts of available information to be continuously analysed in the investment

management process and those data inputs form the basis of Smart Beta solutions in a consistent, repeatable manner.

SINGLE-FACTOR SMART BETA SOLUTIONS

Not all Smart Beta solutions are created equally! Single-factor solutions hone in on one factor only focus on one of the stock characteristics or drivers of return.

For example, a solution that only includes stocks in a portfolio based on valuation, will basically only consider stocks that are cheap and rank these accordingly for portfolio inclusion. A deeper analysis of why the stock is cheap may reveal legitimate reasons for the valuation, such as low quality.



Therefore, a more efficient, in-depth analysis of each stock may 'flag' this when considering other stock-level characteristics such as quality, investment, momentum or risk factors. This multi-factor, stock-level strategy ensures that an optimally constructed portfolio of stocks includes all information and data that is available. A multi-factor strategy also avoids a catastrophic collapse, as all 'other' critical information about a stock is considered simultaneously in the rigorous research process.

From a risk management perspective it is prudent to have a diversified investment portfolio, and the same applies to factor investing. We believe it is important to diversify away from single-factor portfolios, and to adopt multi-factor strategies.

A unique multi-factor, Smart Beta approach The Fairtree Smart Beta team has developed a robust, in-house multi-factor investment philosophy and process in managing their local and global Smart Beta solutions. The systematic method whereby information and data is analysed in the investment process means that the team is one of the largest consumers of Bloomberg data in the world (stock-level data from 22 stock exchanges around the world, has been collected since the year 2000).

The in-house system developed for the management of Smart Beta strategies is cutting edge and is easily adaptable to include and account for new information as it becomes available.

UNDERSTANDING THE 'FACTORS' IN A MULTI-FACTOR STRATEGY

The Smart Beta strategy deployed by Fairtree Capital begins with a process that:

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Academic Root is relative to these five factors

- Trims the investable universe to include the most liquid and tradeable stocks
- Ranks the remaining companies according to each of the factor scores
- Construct a portfolio to maximise the potential and minimise the risk

The academic ‘roots’ and published papers relative to each of the five factors are depicted above.

PORTFOLIO CONSTRUCTION CONSIDERATIONS

Fairtree Capital’s local and global Smart Beta strategies are market-leading as a result of a multi-factor investment philosophy and process. The solutions are also agnostic of equity styles and sectors and include a limited number of shares based on the systematic application of information and data in a methodical, repeatable manner.

Research has shown that including Smart Beta strategies with active equity management has the benefit of contributing

to additional portfolio return, but without increasing the level of portfolio risk. It is possible to generate superior risk-adjusted returns by blending or combining Smart Beta solutions with traditional active equity

management. The diversification benefits of this approach include lower portfolio drawdowns, a better Sharpe Ratio and improved risk-adjusted returns.

Table 1

Top Asset Managers (minimum ZAR 5 Billion) in South Africa Sorted by Asset-Weighted Rating

| Rank | Asset Manager | Rated Assets Bn ZAR | Equal Weighted Rating | Asset Weighted Rating | Equity | Fixed Income | Allocation | % Assets 4 & 5 star |
|------|---------------------------------|---------------------|-----------------------|-----------------------|--------|--------------|------------|---------------------|
| ★ 1 | Fairtree Capital | 5.4 | 4.00 | 4.98 | 5.00 | 5.00 | 2.00 | 99% |
| ↓ 2 | Allan Gray Unit Trust Mgmt | 258.2 | 4.67 | 4.84 | 4.33 | 4.00 | 5.00 | 100% |
| ↑ 3 | PSG Collective Investments | 29.8 | 3.50 | 4.31 | 3.92 | 3.00 | 4.43 | 93% |
| ↑ 4 | First Global Group | 6.0 | 3.83 | 4.22 | 3.00 | 3.00 | 4.42 | 83% |
| ↑ 5 | Personal Trust Intl Mgmt Co | 6.7 | 3.20 | 4.12 | 1.00 | 2.00 | 4.57 | 68% |
| ↑ 6 | Coronation Management Co | 241.2 | 3.75 | 4.10 | 3.97 | 4.77 | 4.00 | 88% |
| ↓ 7 | Prudential Investment Managers | 73.3 | 3.70 | 4.02 | 4.29 | 3.07 | 4.00 | 96% |
| – 8 | Foord Unit Trusts | 75.2 | 3.50 | 3.97 | 3.96 | - | 3.97 | 97% |
| ↓ 9 | PSG Multi-Management | 45.6 | 3.58 | 3.91 | 3.94 | 3.48 | 3.98 | 91% |
| ↓ 10 | Rezco Collective Investments | 8.3 | 3.67 | 3.91 | 4.00 | - | 3.91 | 91% |
| ↓ 11 | Prescient Management Co | 33.4 | 3.12 | 3.86 | 2.94 | 3.90 | 3.78 | 86% |
| ↓ 12 | Sygnia Collective Investments | 12.4 | 3.54 | 3.82 | 3.14 | - | 4.00 | 82% |
| ↓ 13 | Nedgroup Collective Investments | 131.6 | 3.86 | 3.76 | 3.56 | 3.59 | 4.01 | 65% |
| – 14 | Momentum Collective Investments | 42.2 | 3.28 | 3.70 | 4.26 | 3.58 | 3.08 | 58% |
| ↓ 15 | Investec Fund Mgrs SA | 124.4 | 3.19 | 3.63 | 3.49 | 3.30 | 3.78 | 66% |



CONCLUSION

Scientific methods and processes applied to investment theory and data provide a burden of proof that is difficult to ignore. Smart Beta strategies combine the best characteristics of both passive and active investing, along with fundamental investment principles and rigorous risk management.

Smart Beta provides a middle ground between active and passive investment strategies. The information, maths and strategies of active investing are combined with the low cost of passive investing – providing the best probability of obtaining superior investment outcomes.

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It's difficult for investors to correctly and consistently select active fund managers that will outperform the index or benchmark in future.

It's equally as difficult to select the next best-performing stock that outperforms the index.

One of the most attractive features of a Smart Beta approach is that the strategy is clinical, scientific and repeatable. Smart Beta also avoids human emotion and nullifies possible traps that active managers may sometimes fall into i.e. falling in love with a stock or being influenced by boards or management teams.

The global rise of Smart Beta is exponential. Assets invested in Smart Beta assets in the US recently topped a record level of US\$640bn.

Despite SA still being behind the curve, the rise and importance of Smart Beta will soon blur the lines between passive investing and traditional active management. **Wn**



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Inspect floor heating



Detect building anomalies



a Transmission system, Distribution systems and the Generation sources will eventually only be embedded generation and Independent Power Producers, and will use renewable energy.

Thus the Current Industrial Evolution will be an Electricity Supply Industry supplied by renewable energy only.

The catalysts for the Current Industrial Evolution are costs of traditional generation, the environmental requirements on generators, and developments of technologies in the Fourth Revolution – especially Smart Grids, and components thereof – embedded generation (mainly Solar at this stage), storage, communication, and metering to mention some of the main components.

To understand why this impacting on the traditional electrical utilities, both Eskom and Municipal undertakings, will be discussed:

ESKOM

- formed by statute in 1923. It is a vertically integrated organisation consisting of Generation, Transmission, and Distribution. It also manages and funds non-core activities such as research and training.

In late 2007, and early 2008, Eskom was unable to meet the Peak Maximum Demand on the system. Load-shedding measures had to be instituted to ensure that there would not be a catastrophic black-out. Since 2008, the peak demand has effectively levelled out at 35 500 MW (assuming the average of peak demand for the 10 years 2008 to 2017). This is compared to a projected peak of 45 000 had it grown at the assumed 2,18% (refer to the proposed Department of Energy's plan - IRP2016 – see table below). This is a decrease of 9 500 MW in demand, which many people assign to slower growth. (See the figures in the table.)

As the amount of power supplied by Eskom in the past has been recognised as 95% of the power supplied to South Africa, the peak demand for South Africa was assumed to be that of Eskom's. This assumption has not been tested to my knowledge, and one can safely assume that the drop in Eskom's peak demand is also attributable to installed renewable generation - both embedded, and Independent Power Producers not supplying the Eskom grid. These installations can easily be witnessed in car parks,

| YEAR ENDING | PEAK DEMAND | | INSTALLED |
|-------------|-------------|---|-------------|
| | MW | | Capacity MW |
| 2022 | 37 951 | * | 58 916 |
| 2017 | 34 072 | * | |
| 2016 | 33 345 | | 45 075 |
| 2015 | 34 768 | | 44 281 |
| 2014 | 34 977 | | 44 189 |
| 2013 | 35 525 | | 44 206 |
| 2012 | 36 212 | | 44 115 |
| 2011 | 36 664 | | 44 145 |
| 2010 | 35 850 | | 44 175 |
| 2009 | 35 959 | | 44 193 |
| 2008 | 36 513 | | 43 037 |
| 2007 | 34 807 | | 42 618 |

*Eskom Peak Demand and Installed Capacity
From Eskom Integrated report 31 March 2016
* = calculated at 2.18% growth per annum
(Assumption of the proposed IRP2016)*

and in industrial, commercial, and residential properties. If the total effect of these installations is to contribute 4 500 MW to the country's demand (10% of the projected 45 000 MW), South Africa's peak demand should be 35 500 MW contributed by Eskom divided by 95%, plus 4 500 MW renewable energy, which is equal to 41 868 MW. Therefore Eskom should currently be providing $35\,500/41\,868 = 85\%$ of the country's power. As the trend of installing embedded generation continues, Eskom's percentage supply to the country will decrease and the utility will eventually disappear.

If Eskom's progressive decrease in the percentage power it supplies to the country is recognised, it would be wise to split Eskom up into separate operating companies – Generation, Transmission, and Distribution. The latter two will still be essential to the new Electricity Supply Industry.

In addition, and most importantly, an Independent System and Market Operator should be introduced. (ISMO). The formation of the ISMO was announced by the President in his State of the Nation Address some years ago, and subsequently withdrawn. The ISMO would buy power from the generators and sell it to the Distributors and large power users. As the purchase would normally be in the form of a daily auction, the prices should be more competitive.

The analysis above is based on power since the data is readily available, but the same logic would also apply to energy.

A further factor is the cost of Eskom power. In the past, Eskom power was recognised as one of the cheapest power suppliers

Industrial Evolution

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globally. This resulted in a long pay-back period for investments in alternative power sources. However, over the past number of years, Eskom has been granted large increases in their tariff by the National Energy Regulator of South Africa – NERSA. The latest increased tariffs, combined with the ever decreasing costs of renewable power generation equipment, translate to a very favourable rate of return on investment – even for small consumers such as the householders.

The current Eskom application to NERSA is for an 19,9% increase, effective 1 April 2018. Eskom is experiencing increased overheads, and no increase in revenue, as outlined above. Their overheads, however, are increasing- especially finance costs and depreciation. My estimate at this time, is that primary energy accounts for 45% of their revenue, employment costs 14%, depreciation 12%, and finance costs 16% (and growing!) If this increase is granted, it would provide a further impetus for renewable energy investments in the Country.

MUNICIPAL UTILITIES

These organisations buy power from Eskom and resell it to consumers in their distribution area. A few do have their own generation capacity, but this is a small percentage of the total requirement.

The economic model to re-sell electricity is flawed: The price is determined by adding together the base price from Eskom, an allowance for operating, maintaining, and replacing equipment, AND a fairly substantial mark-up, which is used to subsidise other services provided to their constituencies. The danger in this model is that, as the demand for electricity decreases,

so does the mark-up decrease. The utility then finds it difficult to fund their other services. As embedded generation is becoming more prevalent in residential areas, the decrease in electricity sales, and thus in the mark-up, is already happening. Alternative tariffs, which include a service fee, are already being debated. The service fee, however, is tantamount to a tax on electricity users, and will serve to encourage more consumers to install their own generation.

The right of the Municipal Utilities to distribute and sell electricity is contained in the constitution. If Eskom is split up as proposed above, there may be pressure for the Utilities to become distribution companies in their own right, alternatively, to merge with larger distribution companies. The ISMO would have a role to play in selling power at wholesale prices to the distribution companies.

The discussion above is also applicable to other countries. Germany has been in the forefront of installing renewable energy – wind in the North, and solar in the South. In addition, Germany has taken the decision to phase out its nuclear power stations. Denmark, which used to import coal from South Africa by the ship-load for their fossil fuelled power stations, has installed wind generation. A short time ago, Denmark announced that, on the previous day, their entire twenty-four hour power requirement had come from the wind generators.

A further motivation to transform the Electricity Supply Industry to renewable energy, is the commitments from the various governments to “go green”. In the process, Carbon Credits are earned, which

also contributes to making the investments more attractive.

Although I am claiming that the Current Industrial Evolution has already started, one cannot assign an exact date, as is the case with the four Industrial Revolutions that preceded it.

Thus the Current Industrial Evolution will be an Electricity Supply Industry supplied by renewable energy only.

This obviously will not happen immediately, but as the existing large power stations reach their end-of-life, they should not be replaced. Because of the advances in renewable energy generation and storage technologies, combined with the decreasing prices, this revolution will gather speed, and the Current Industrial Evolution will become a reality.

Solar Energy is plentiful - a consultant has stated that the amount of solar energy received on the Earth in 14 minutes is sufficient to supply all the Earth's requirements for one day!

The present technology for harvesting it is fairly inefficient but the efficiency developments in the technology will make the argument for using solar even more compelling in the future. **wn**





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Upliftment Of Semi-Skilled Workers To Artisan Status

BY | MANFRED MICKLEIT | SMSAIEE

A country's education and training policy usually has two main objectives: to meet the demand of individuals for their own development; and to meet the needs of society for its general development.



In a free society the first objective is served by making education available to all citizens, irrespective of class, race or income. The second objective is served by seeing to it that commerce and industry, as well as cultural and public institutions are served by people with the prerequisite general education and skills.

The motto “Give a man a fish and you feed him once. Teach a man to fish and you feed him for lifetime” has been used to embark on a project to uplift black semi-skilled workers to artisan status, thereby contributing to the central goals of the reconstruction and development programme (RDP). This project holds the key to unlocking South Africa’s potential skills, and thereby improving productivity, assisting in developing a strong dynamic balanced economy, and creating social upliftment of its working class.

One of the greatest challenges facing managers in South Africa today concerns the training of the country’s semi-skilled labour force. South Africa is in the unique position of having to deal with a great shortage of skilled workers on the one hand, and a high unemployment rate among unskilled workers on the other hand. Consequently, it can be said that unemployment can largely be attributed to a lack of training, resulting in poverty and misery, which in turn leads to serious social problems. In the light of the above-mentioned it is very important to look at a short history outlining the cause of the present state of affairs.

The Cape Colony fell under the jurisdiction of the Dutch East India company (DEIC) for nearly a century and half, namely from 1652 to 1795. The DEIC bears the stamp of early capitalism. The economic life of the colony was exclusively directed towards the mother-country, and little effort was made in the upliftment of its indigenous people. Slavery played an important part in the development of the Cape Colony. It was initiated by Van Riebeeck in 1657, but its importance culminated in 1679 when

Upliftment of Semi-skilled

continues from page 45

large numbers of slaves were imported from Madagascar, India, Malaysia and Indonesia. Consequently, there were fewer opportunities for local agricultural labourers to obtain work, for they could not compete with slave labour. Moreover, manual labour done for financial remuneration was rated as slave labour. In 1717 white emigration from Holland diminished as the DEIC withdrew subsidies of white emigres to the Cape Colony, resulting in forced cheap slave labour.

In 1814 Britain became the lawful owner of the Cape, with the concept that all people were born free and equal, and had to right to elect their own government, and to dismiss it from office if it proved inefficient. Slave-trade was prohibited in 1834.

The massive immigration of British settlers during 1820, as well as approximately four thousand German soldiers in 1857, settled in the Eastern Cape. This influx of European immigrants retarded the training process of the indigenous people.

The discovery of gold and diamonds between 1867 and 1870 changed labour relations to the detriment of the indigenous people. For the first time, Africans and Coloureds (mixed race) came from far and wide to seek employment on the mines to earn money, and then return to their kraal after a few months. It was the start of a massive non-white labour migration to the Transvaal as well as the detribalisation of the Africans. Africans were used exclusively as labourers on the mines.

They were housed in compounds, without their families, and used for unskilled work. An African proletariat soon congregated around the white towns and mining villages.

The end of the Anglo-Boer War in 1902 opened the way for the unification of the four provinces, which took place in 1910, resulting in unfavourable economic conditions for the white Afrikaner population. Many Afrikaners moved to the mines because the countryside had been devastated, and the Afrikaner people were impoverished.

The Mines and Works Act was promulgated in 1911. It consolidated a variety of existing acts relating to the conditions of employment in South African mines. An important aspect of the act was the introduction of what is known as the colour bar, the reservation of specific types of skilled employment. For the first time the principle of restricting skilled, highly-paid employment to Whites only was applied in the non-agrarian sphere.

The movement of unskilled rural Whites (mostly Afrikaners) into semi-skilled, non-agrarian occupations, in which they experienced the competition of non-Whites, and the Union government's desire to solve the poor-White problem, were responsible for the colour bar being placed on the statute book. The various trade unions prohibited the training of African people and this led to the African workers' resistance and eventually to the formation of the Council for Non-European Unions.

The National Party was elected in 1948, and thereafter labour legislation was to follow the ideology of apartheid, and This intensified the racial division in industrial relations. A prohibition was placed on the formation of racially mixed trade unions, and job reservation was created to protect White workers from competition in most areas.

In 1973 widespread strikes by African workers took place throughout the country, crippling and eroding the country's economy. The Soweto riots in 1976 called for disinvestment in South Africa from overseas, and this, as well as the shortage of skilled workers, were some of the pressures to which the government had to respond. The Wiehahn Commission was established to attend to these problems and its recommendations, which were submitted in February 1979, were well-received.

Major recommendations were:

- a) Granting of the freedom of association to all workers, irrespective of race and status.
- b) Apprenticeship to be open to all races.
- c) Appointment of a National Manpower Commission.

It has often been stated, that history is the result of the interaction of a multitude of forces. Some of the contributing forces for not training the country's indigenous people have been outlined. But no single force can offer a complete interpretation of South Africa's past history.

South Africa's case of not training its indigenous people is not unique. For example, in the United States, before the First World War, craftsmen who arrived in America from Britain and other European countries were all qualified, i.e. skilled craftsmen were imported "ready-made", and there was no need for training. The Smith-Hughes Act of 1917 led to serious thought being given to the apprenticeship problem, and brought about the real beginning of a regularised indentured apprenticeship, which dates back to 1920. It was, however, not until 1937 that Congress, adopting the Fitzgerald Act, formally recognised the



national interest in the systematic training of all-round skilled workers.

In South Africa the following events gave impetus to the training of semi-skilled workers in local authorities:

- a) The Manpower Training Act, 1981 (Act No 56 of 1981)
- b) The establishment of the Apprentice training Board for Local Authorities (ATBLA).
- c) The establishment of an accreditation committee to deal with specific issues of the ATBLA.
- d) The implementation of competency-based modular training.
- e) A visit to twenty municipalities in the Western Cape to establish their training needs.

THE MANPOWER TRAINING ACT, 1981 (ACT NO 56 OF 1981)

This Act provides for the promotion and regulation of the training of manpower. A National Training Board was established to provide for the establishment, accreditation, function and powers of training boards for the various industries, i.e. motor, electrical, metal, etc., and the registration of regional training centres, private training centres and industrial training centres, as well as the imposition on certain employers of a levy in aid of training.

THE ESTABLISHMENT OF THE APPRENTICE TRAINING BOARD FOR LOCAL AUTHORITIES (ATBLA)

The ATBLA was established on 22 March 1989. On 24 November 1989 the Minister of Manpower, in Government Gazette No 12189, promulgated by Government Notice No 2557, authorised the ATBLA to manage the functions of a training board.

ATBLA was now responsible for the management of technical training in local authorities, the taking over of the apprenticeship system, and the drawing up of new conditions of apprenticeship. One of the most important functions was to change the time-based system of apprentice training to a system of competency-based, modular institutional training.

THE ESTABLISHMENT OF AN ACCREDITATION COMMITTEE

On 22 March 1989 the ATBLA established an Accreditation Committee as a permanent subcommittee of the Board to attend to all technical training aspects.

The accreditation Committee consists mainly of Electrical and Civil Engineers, two members of the Municipal Employer's Organisation and one member of the Evaluation Committee of the National Coordinating Training Committee. The writer was appointed to serve on the Accreditation Committee in 1994.

THE IMPLEMENTATION OF COMPETENCY-BASED MODULAR TRAINING

The competency-based modular training programme focuses on the ability of the learner to master a specific skill. In other words, the training programmes comprise a set of learning, or performance objectives that are clearly defined, and that can only be attained if specific actions or tasks are carried out.

A further characteristic of a competency-based modular training programme, is that the individual learner will be held responsible for the successful mastery of a performance or skills objective, while the trainer manipulates, and uses external

conditions, in an attempt to ensure that the learner will obtain the required level of mastery. Competency-based training can therefore be regarded as the equipment for the compilation of new programmes, and for the replacement of old practices with more flexible training methods that have proved themselves.

A VISIT TO TWENTY MUNICIPALITIES IN THE WESTERN CAPE TO ESTABLISH THEIR TRAINING NEEDS

In February 1995, on the instructions of the ATBLA, the writer visited twenty large municipalities in the Western Cape to obtain statistical data of their training needs for technical staff. The data obtained by all accredited committee members around the country was submitted to the ATBLA, and revealed that in most parts of the country, no training of electricians at all has taken place in the past fifteen years.

The accreditation committee, therefore, as a matter of urgency decided to embark on a scheme to train trade-related workers on a large, scale in order to maintain a complete, efficient local authority electricity supply system, and to fulfil its duty to the industry and its consumers.

The lack of training in other categories showed a similar pattern. The graph in Table 1 shows the decline in apprentice training in the Metal Industry.

Another reason for the urgent need to train our indigenous population will become clear if we look at some of the statistical data.

Statistics reveal that the African population constitutes the largest percentage of the

Upliftment of Semi-skilled

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**METAL AND ENGINEERING INDUSTRIES (South Africa)
APPRENTICE INTAKE 1982 - 1996**

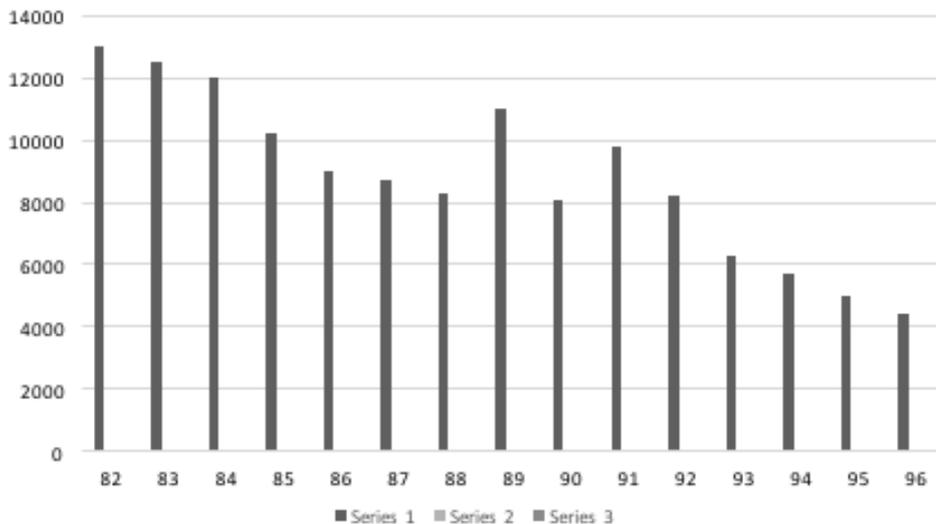


Table 1

total economically active population, namely 70.31% followed by Whites 18.61%, coloureds (mixed race) 8.83% and Asians 2.25%.

Of the approximately 14 million economically active African workers, only 4.7% can be classed as skilled or semi-skilled, with a massive 95.3% classed as unskilled. The proportion of skilled workers in the economically active workforce of the other racial groups is 37.6% for Asians, 12.1% for Coloureds and 57.8% for Whites.

The preceding statistics clearly reveal a tremendous burden on the professional and skilled White economically active population. The question may rightly be asked whether South Africa will, owing to this state of affairs, be able to deal with the challenges of the future in terms of economic growth, and the associated creation of job opportunities.

THE (ATBLA) AND THE TRAINING OF SEMI-SKILLED, TRADE-RELATED WORKERS

On 25 February 1994 the ATBLA requested the Department of Labour's permission to manage the training of employees in trade-related posts (i.e. operators, general workmen, special workmen, etc.) with a view to providing career paths to the level of tradesman. On 21 March 1994 the Department of Labour advised the ATBLA that the training of employees in trade-related posts could be managed by the ATBLA, since the application of section 28 of the Manpower Training Act, 1981, with regard to the local authority undertaking, had become part of its activities.

The ATBLA therefore became the authoritative body for the local authority undertaking that administers the system for the management and control of trade testing. Consequently, the ATBLA can

determine what training the employees in trade-related posts should undergo, and the level of experience that should be gained, so as to eventually comply with the requirements of section 28 of the Act.

The ATBLA was of the opinion that the training of all persons, in trade-related posts, or within one job family, should be done with a holistic (systematic) approach. The following diagrammatic exposition indicates how an employee can advance from the lowest level in the field of electrician, to the level of City electrical Engineer.

Members of the accreditation committee were asked to develop training modules for the various trades. The writer compiled the syllabus for automotive electricians. Consultants appointed by the Board structured these modules into suitable learning manuals, to be used for the proposed training of semi trade-related workers.

The ATBLA will certify trade-related employees on the following four levels:

- Trade Worker (level 1)
- Trade Worker (level 2)
- Trade Worker (level 3)
- Trade Worker (level 4)
- Trade Test
- Tradesman

The modules of the ATBLA's courses in each trade were combined for each level, so that a logical build-up followed from the easiest to the most difficult task.

The employee at the lowest post level should, for example, master the basic modules of hand tools. Thus, an employee can progress from a Trade Worker (level 1) to a qualified



Tradesman with a combination of certain modules.

With regard to the admission requirements, the “open entry, closed exit” concept was applied and a career path was created for employees. The following prerequisites for the training of trade-related workers were determined by the Apprentice Training Board for Local Authorities.

- The age restrictions applicable in terms of the various acts and conditions of service also apply to training.
- The employee must be medically fit for the activities of the post in which the training is done.
- Psychometric and practical trainability tests must be successfully completed.
- Must be able to read and write.

A trade-related worker will obtain institutional training in an accredited training centre, as well as practical training in the work situation. Each employee undergoing training in terms of this scheme, will be issued with a logbook for in-service training for each module. With regard to each module, a qualifying “level test” (phase test) must be done to eventually attain accreditation.

With the successful completion of the required range of training modules for each level, the ATBLA will issue a certificate to the person under the signature of the Registrar of Manpower Training. A person who has undergone all the modules of a tradesman course, will also have to undergo a trade test under the guidance of the ATBLA.

The ATBLA has to maintain an updated a national data base of all employees in trade-

related posts in all local authorities. All the modules completed by the employee are added to the data base.

The employer (local authority), the employee and the ATBLA, are the three parties involved in the partnership, and they must ensure that all employees in trade related posts undergo training according to their potential and the planned training programme.

Workers in trade-related posts will undergo training similar to that of tradesmen, but this training is not time-based. Structured qualification levels have been determined for each level by combining certain modules of the ATBLA’s courses.

The ATBLA compiled training programmes for trade-related workers in the following trades:

- Electrician
- Vehicle Mechanic
- Fitter and Turner
- Plater and Welder
- Auto Body Repairer
- Carpenter and Joiner
- Bricklayer
- Plumber
- Painter and Decorator
- Automotive Electrician
- Jointer
- Welder
- Motor Mechanic
- Diesel Mechanic
- Fitter

It was decided by the Accreditation Committee that the above-mentioned scheme be communicated to all employees in trade-related positions at the various municipalities.

TRAINING OF TRADE-RELATED, SEMI-SKILLED WORKERS IN THE CAPE PENINSULA

Prior to the implementation of the training of trade-related, semi-skilled workers in Cape Town, the writer in 1991 established an overhead line school. He compiled a learning guide called “Practical Hints and Safety Procedures for Personnel Working on Overhead Electric Lines for Voltages up to and including 11 kV”.

The Electricity Department of the City of Cape Town employs workers for the maintenance of the high/low voltage overhead network. Training is generally done “on-the-job”. A worker progresses through the ranks of linesman, senior linesman, faultsman and senior faultsman. A faultsman/senior faultsman should be well-experienced in overhead mains work, be able to write legibly, and be capable of dealing courteously and tactfully with members of the public. These groups of workers are effective because they are specialists in their limited range of operations. Formal theoretical training at a recognised Technical College does not take place. The Occupational Health and Safety Act requires that special attention be paid to safety training in so far as it affects the worker himself, the public, his fellow-workers and the department’s equipment.

The overhead line school consists of a classroom and open-air training facilities. Instructors were employed to undertake the overhead training function, and each worker has to pass a written as well as a practical examination, before a certificate of compliance is issued. The course was a great success, and during the past six years a total of 450 workers have obtained certificates of acceptance. The success of

Upliftment of Semi-skilled

continues from page 49

the above school inspired the writer to commence training for the upliftment of semi-skilled workers to artisan status.

For the writer to convince operational management in local authorities that all population groups in South Africa have to be trained in large numbers to sustain economic growth, and the creation of job opportunities for thousands of school-leavers, required more than a spirit of enterprise.

Accordingly, the writer arranged a function at the Cape Town Civic Centre Lecture Theatre. Managers, technical colleges and trade union staff were invited to the function. The Chief Executive Officer of the ATBLA spoke on “The role of the Apprentice Training Board in the training of apprentices”, while Mr J Burger, Chief Technical Officer of the ATBLA, discussed the “Incorporation of Practical Training of semi-skilled workers with that of Apprentice Training”.

The function was a great success, and on 25 May 1994 a report was submitted to the Utilities and Works Committee by the City Electrical Engineer, obtaining permission to hire premises for a large Technical Training Centre for semi-skilled workers. Premises with office and classroom space of 400 m² and a workshop of 590 m² were obtained at 37 Berkly Road, Maitland. The new Technical Training centre was officially opened by Alderman Theresa Solomon, Mayer of Cape Town, on Tuesday, 21 November 1995. The first group of semi-skilled workers commenced classes in 1996.

Official application forms for the training of semi-skilled workers were sent out to all branches of the department.

The Cape Town Technical Training Centre was accredited by ATBLA to train semi-skilled workers in the trade of electrician and automotive electrician. In order to facilitate training of workers in the other trades, the writer arranged that Westlake Technical College be accredited in the training of plumbers, motor mechanics, fitter and turners. Westlake has the required staff and is fully equipped to undertake such training.

In October 1996 the first group of semi-skilled workers obtained their Trade Worker Level 1 certificates of competence from the Mayor of Cape Town. It was a proud occasion for the entire training staff as we had proven beyond doubt that previously disadvantaged workers could be trained successfully. A comparison of the training schedule of apprentices and that of semi-skilled workers in local authorities may be of interest to the reader.

REQUIREMENTS FOR LEVEL 1

In order to obtain a Level 1 certificate a candidate must complete the following modules: A01, A02, A03-A, C01, C02, C03, C04, D03 and F02. A training module must be completed successfully by means of a modular test.

The modular training process is part of a broad national commitment to education as part of the reconstruction and development of South Africa along democratic lines. There is the belief that upliftment through education is an important element in the economic recovery of a nation, after years of political turmoil, economic isolation and hardship. For the young there is a restructured schooling system intended to prepare children from all backgrounds for adulthood and career advancement. The system will eventually place greater emphasis on skills-development. For adults with little or no education, a system of Adult Basic Education has been introduced, which teaches rudimentary literacy in the mother tongue and English, to open the door to formal training and personal upliftment. Among adults in this situation, are many who possess basic literacy and have progressed as semi-skilled workers, but have been denied apprenticeships, or have not had the opportunity to study or train for qualification. Often it is they who do the job from start to finish, albeit under supervision. It is for the benefit of these semi-skilled workers from disadvantaged backgrounds that trade apprenticeships via the modular training system have been introduced.





The achievements of Mr Trevor Geswindt in becoming the first semi-skilled worker to pass his government trade test, thereby becoming a fully-qualified artisan, provides a noteworthy example of how this programme works. Mr Geswindt comes from a disadvantaged background where youngsters leave school early in search of work. He secured a job as a casual labourer in the Electricity Department of Cape Town City Council in 1982. Later the same year he was placed on the fixed establishment of the Steenbras Power Station as handyman. Applying himself to his work he rose through the ranks to become senior-handyman in 1996. When offered the opportunity to undertake trade training at the Westlake Training centre as part

of the Council's upliftment programme, he did not hesitate. He chose the trade of fitting and turning, in which he had already developed skills, successfully completing all course-modules within one year.

He passed his trade test at his first attempt on January 20, 1997. Mr Geswindt's Trade Diploma was presented to him on March 4, 1997 by Mr Andrew Boraine, City Manager of Cape Town.

A major point that contributed to the success of the above-mentioned scheme, is the fact that each training module passed in an accredited training centre is not time-based. The worker can progress through the modules at a pace best suited to him.

In conclusion I would like to quote the following words from Gustav Pansegrouw, a management psychologist:

"The eagle, a prince among birds, symbolising the key attributes of strength, competence, courage and freedom".

These are vital attributes that will be crucial in South Africa in the next decade if we as a nation are to free ourselves from the mistakes of the past.

Through the training process of semi-skilled workers, we will master the soaring freedom of flight and will find a constructive solution to our training problems, which will be a contributing factor to economic growth in the new South Africa. **wn**



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Entropy and Holism represent two principles of nature, seemingly both contradictory and complementary, which are fundamental to the existence of the universe and conscious life, similar to the Yin-Yang of ancient Chinese philosophy.



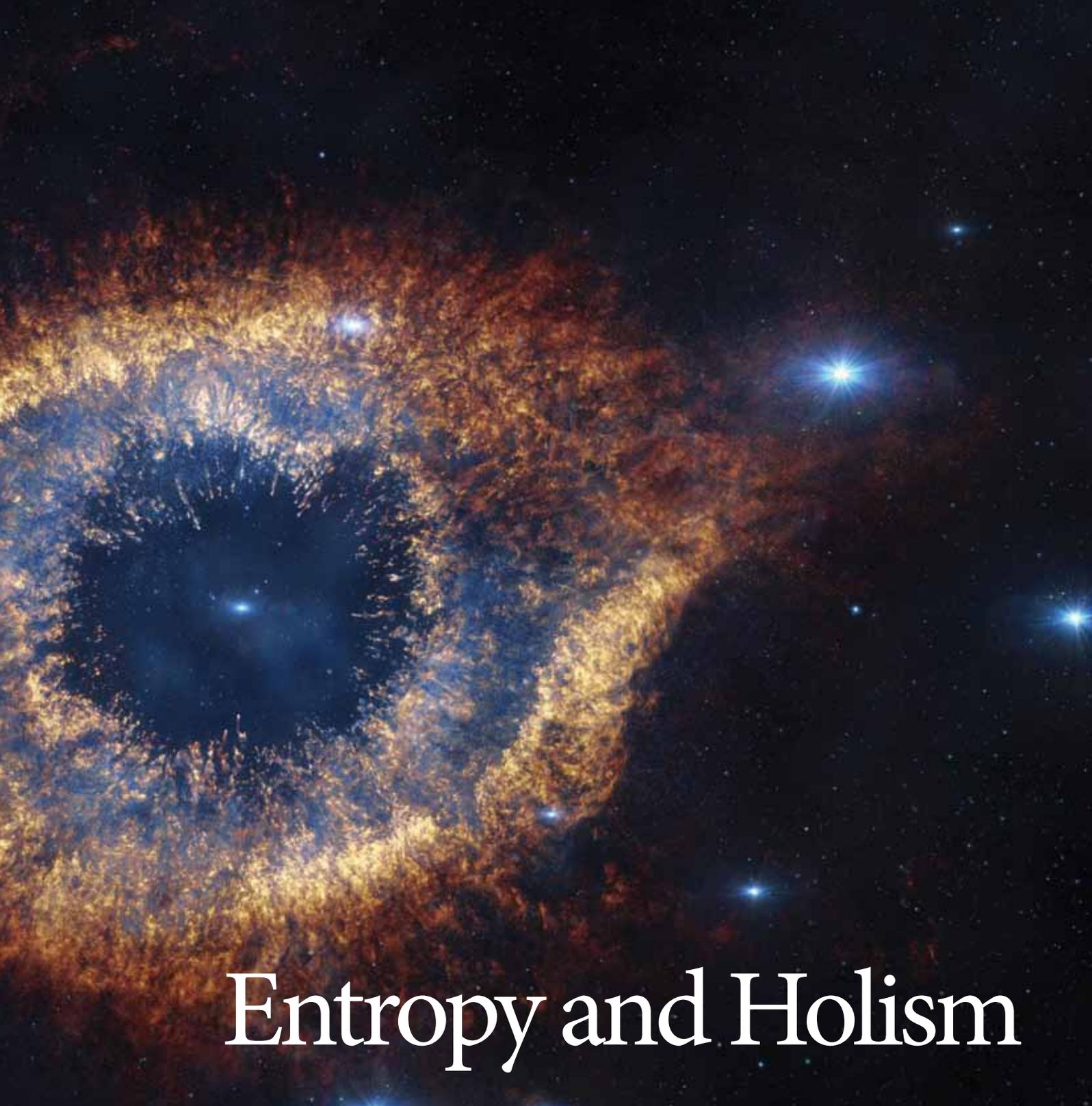
BY | DUDLEY BASSON

Every student of thermodynamics will be familiar with the concept of entropy, but this does not only apply to heat engines.

Entropy is of fundamental nature and applies to any statistical system of elements, where there can be a change from order to disorder. Entropy has application in

chemistry, financial planning, marketing, actuarial science, information theory, public poll predictions, conspiratorial theories etc.

Entropy also implies that heat can only flow from a hot substance to one that is colder.



Entropy and Holism

Entropy is a function of state which cannot be directly measured. It has the units joules per kelvin.

Temperature-entropy (T-S) diagrams are widely used in thermodynamic study. The abstract nature of entropy may make this seem daunting to students new to thermodynamics.

Willard Gibbs commented:

“Any method involving the notion of entropy, the very existence of which depends on the second law of thermodynamics, will doubtless seem to many far-fetched, and may repel beginners as obscure and difficult of comprehension.”

Max Planck complained that his students regarded entropy as a mathematical spook.

Nicolas Léonard Sadi Carnot (1796-1832) was a French military engineer and physicist, often described as the “father of thermodynamics”.

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*Sadi Carnot in his cadet uniform of the
École Polytechnique*

In 1824 Sadi published his “Reflections on the Motive Power of Fire” (*Réflexions sur la puissance motrice du feu et sur les machines propres à développer cette puissance*) which gave the first successful theory of the maximum efficiency of heat engines.

The second law of thermodynamics can be stated as: The entropy of the universe tends to a maximum. The second law is applicable to a wide variety of processes, reversible and irreversible. All natural processes are irreversible.

A major contribution to the study of heat flow was made by Jean-Baptiste Joseph Fourier (1768 –1830) in his work “Analytical Theory of Heat” (*Théorie analytique de la chaleur*). Every student of electrical engineering will be familiar with the Fourier Series and Fourier Transform.

Carnot’s idealized four process heat engine (Carnot Cycle) with the theoretically maximum possible thermal efficiency, is

fundamental to thermodynamics, and has a direct bearing on entropy. This showed that the maximum efficiency was determined only by the temperatures of the hot source and cold sink and not by the nature of the thermodynamic fluid.

This also shows that the maximum efficiency of the Rankine cycle of steam driven power stations can only approach 50% if the steam is used at supercritical temperature and pressure.

Normally, most of the energy produced at a power station goes to waste in the cooling towers. Great savings can however be made by utilising the waste heat for district heating as is done in Denmark.

Great advances were made in thermodynamics by Clausius, Planck, Lord Kelvin, Maxwell, Gibbs, Watt, Fourier and others. Further information on the development of thermodynamics and the various thermodynamic cycles can be found in the November 2015 issue of **wattnow**.

Reversing entropy will require intervention of some type: input of heat, mechanical energy, intelligent ordering etc. Reversing (lowering) entropy without intervention implies a reversal of the passage of time.

The irreversible passage of time is famously expressed by Persian poet, mathematician, astronomer and philosopher, Omar Khayamm (c.1044-1123) in quatrain LXXVI of his Rubaiyat, translated by Edward FitzGerald:

*The Moving Finger writes; and, having writ,
Moves on: nor all your Piety nor Wit
Shall lure it back to cancel half a line,
Nor all your Tears wash out a word of it.*

Omar was far ahead of his time in mathematical methods. He supported his algebraic solutions by geometrical constructions and proofs and was the first mathematician to study and classify cubic equations and employ conic sections in their solution. His treatise on algebra has been in use as a school text in Persia for centuries.

The origin of the universe is now generally accepted as an explosion from a singularity (Big Bang) proposed in 1927 by Msgr. Georges Lemaître (1894-1966). This idea was earlier proposed by Russian mathematician and physicist Alexander Friedmann in 1922. The initial stages and formation of particles is a matter of extreme complexity – suffice to say that this resulted in an explosion of hydrogen and helium gas. Considering only the law of entropy, this gas would continue to expand and cool indefinitely, which is not what is observed. The necessary agency to lower the entropy is gravitation. The compression of matter by its own gravitation plays no part in the thermodynamics of engineering science. However in cosmology, it is of paramount importance for the formation of galaxies, stars and planets, the igniting of nuclear reactions in stars, and the formation of the chemical elements. For stars, planets and galaxies to form, there would need to be some unevenness in the expanding Big Bang material. This has been a matter of intense scientific investigation for decades and has been observed in the residual cosmic microwave background radiation (CMB) of the Universe. This has been described in the June 2015 issue of **Wattnow**. In 2013, the Planck Space Mission of the ESA Cosmic Visions Program, measured the unevenness of the cosmic microwave background radiation with unprecedented

sensitivity and resolution, revealing new information of the age, contents and origins of the Universe.

Theoretical cosmologist Viatcheslav Mukhanov, of the Ludwig-Maximilians-Universität in Munich, proposed a quantum fluctuation model to provide a precise picture model of the crucial initial phase of the evolution of the Universe. This accords with the Planck Mission results. Mukhanov's theory of quantum fluctuations states that the minute inhomogeneities are due to Heisenberg uncertainty.

The Planck data also showed that a previously reported signal, purportedly confirming the existence of so-called primordial gravitational waves, can be largely attributed to dust in our own galaxy. The BICEP3 (Background Imaging of Cosmic Extragalactic Polarisation) team is using a ground-based telescope in the Antarctic Amundsen-Scott South Pole Station to search the CMB for signs of gravitational waves produced immediately after the Big Bang. The BICEP3 and Keck array both observe the CMB at 95 GHz.

HOLISM

The words 'holism' and 'holistic' in modern parlance have come to mean taking a wider view of a situation, to include peripheral situations and consequences.

Holism was originally coined by South African Prime Minister and international statesman Jan Smuts (1870-1950) in his book "*Holism and Evolution*" published in 1926. Smuts regarded Holism as a natural process where the whole is greater than the sum of parts, describing it as a "*fundamental factor operative towards the creation of wholes in the universe.*"



Jan Smuts (1870-1950)

This seems to have been a '*leitmotiv*' throughout his career.

As an example we can consider the parts of a living creature. The various organs and skeletal parts are all quite different, and serve different purposes. Combined they form a complex whole, but the ultimate holistic state occurs as a living creature. Smuts coined the term 'holism' from the Greek meaning wholeness. Smuts studied ancient Greek as an undergraduate at Victoria College, Stellenbosch, where he graduated in 1891 with honours in literature and science.

He went on to read Law at Christ's College Cambridge where he graduated in 1893 with spectacular success. Smuts took a profound interest in the work of American poet Walt Whitman and wrote in 1895, a treatise - 'Walt Whitman: A Study in the Evolution of Personality' (Only published

in 1972). He also took a deep interest in the works of Shelley and Goethe, and later in Keats, Milton and Shakespeare. He would return to Cambridge in 1948 to be installed in splendid ceremony and pageantry as Chancellor of the University. Albert Einstein was highly appreciative of Smuts's holism book, ranking it on a par with his theory of relativity. Churchill commented on the book but it is not clear if he actually read it.

Roy Campbell (1901-1957) was a Durban born South African poet and satirist. He was considered by T. S. Eliot, Dylan Thomas and Edith Sitwell to have been one of the best poets of the period between the First and Second World Wars. He mocked Smuts's book with:

*Statesmen-philosophers with earnest souls
Whose lofty theories embrace the Poles
Yet only prove their minds are full of holes.
(We will return to the 'holes' later.)*

In an attempt to foment the second Anglo-Boer War, Cecil Rhodes conceived in 1895 the idea of a military type raid to be led by Leander Starr Jameson. This raid, doomed before it was launched, was illegal, inept and foolishly planned. He even naïvely thought that the Johannesburg Uitlanders would spontaneously lend their support. General Pieter Cronjé with 1000 mounted riflemen was easily able to outsmart, outflank and arrest the raiders despite their heavy weaponry. This unfortunately did not prevent the outbreak of war. The 18 year old Princess Wilhelmina was inaugurated as Queen of the Netherlands in 1898. Wilhelmina wrote to Queen Victoria, imploring her not to allow the war to happen, but to no avail. Wilhelmina placed the Dutch naval vessel 'Gelderland' at President Paul Kruger's disposal in 1900,

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which he used to travel to Marseille, where he was welcomed by a crowd of 60 000.

Smuts, speaking to humanitarian campaigner Emily Hobhouse said of Kruger:

“He typified the Boer character both in its brighter and darker aspects, and was no doubt the greatest man - both morally and intellectually - whom the Boer race has so far produced. In his iron will and tenacity, his ‘never say die’ attitude towards fate, his mystic faith in another world, he represented what is best in all of us.”

Emily Hobhouse introduced Smuts to Margaret Clark – these two women would have a profound influence on Smuts’s international political career.

Possibly the only good outcome of the Jameson Raid was the famous poem by Rudyard Kipling “If”, which he wrote with Jameson in mind. The lines:

*If you can keep your head when
all about you are losing theirs
And blaming it on you...
If you can talk with crowds and
keep your virtue,
Or walk with Kings –
nor lose the common touch...*

seem eminently suited to Smuts rather than Jameson. Smuts was outraged by the Jameson Raid.

The Second Anglo-Boer War was a traumatic time for South Africa. While on Kommando, Smuts would sometimes stare death in the face while seeing his less fortunate comrades fall.

Smuts lived most of adult life in highly troubled times, which included the second

Anglo-Boer War (1899-1901), the first World War (1814-1918) and the second World War (1939-1945). The biographical bibliography of Smuts is extensive. A full summary of Smuts’s biography cannot be given here – let it suffice to mention incidents in Smuts’s life which are relevant to his holistic philosophy.

After the Anglo-Boer War South Africa existed as four colonies. Smuts saw the holistic advantage in uniting these as a single country, which became the Union of South Africa in 1910. There was great benefit to be had by providing a common system of railways and harbours, a single defence force (which Smuts established as the UDF – Union Defence Force) a common postal service, currency, etc. Including South West Africa and Southern Rhodesia would have been advantageous but was not possible. The country was very richly endowed with natural resources: Mining – gold, diamonds, iron ore, coal, platinum, manganese, chromium, vanadium etc., Farming – maize, wheat, sugar cane, sunflower, fruit, vegetables, cattle, sheep, sea fishing, etc. The potential for export and utilising unskilled labour was phenomenal.

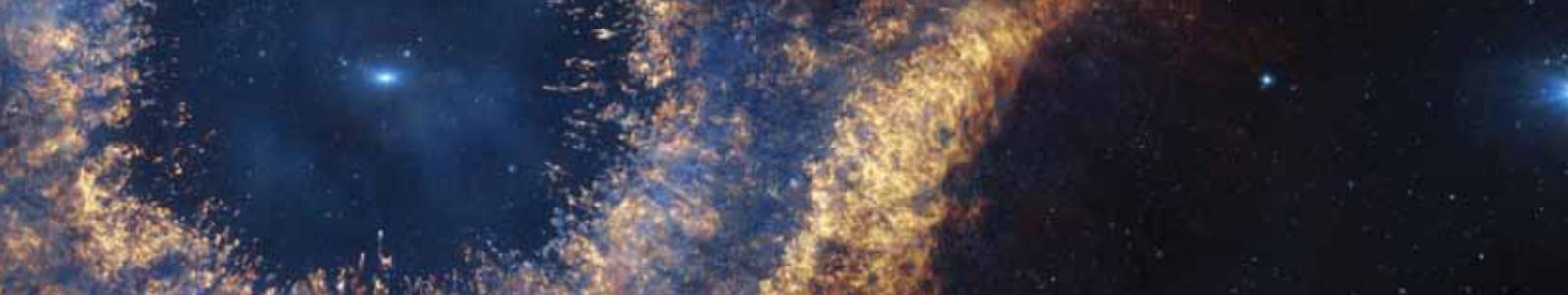
The political climate after the war was deeply divided by language, culture and ethnicity as well as deep post-war resentment. There was no possibility of turning this political witch’s brew into a fragrant bouquet of harmonious politics. The hope of including the entire population in a democratic government was impossible. This would become a political tin can which would be kicked down the road, amid growing social unrest, until 1994. The ‘Democracy’ (Δημοκρατία) of the ancient Greeks is usually regarded as the finest possible form

of government; however it has a fatal flaw. It relies on an educated population that will make informed choices of competent candidates to be placed in power to promote the prosperity of the country. In a population with deep divisions an election merely becomes a self-destructive census. Churchill commented: “*Democracy is the worst form of government except for all the others that have been tried*”.

In 1917 Smuts arrived in Britain as head of the S.A. delegation to the Imperial War Conference. He was warmly received by Lloyd George who offered him a place in the War Cabinet. He became a Privy Councillor and in 1918 was largely responsible for the establishment of the Royal Air Force.

Smuts and Prime Minister Louis Botha took part in the negotiations at the Versailles Peace Treaty in June 1919. Smuts also took part in the establishment of the League of Nations in 1920. It was hoped that this would prevent that a World War would ever happen again. This was less than satisfactory. The League had no power of enforcement and the USA and Germany were not signatories and Russia was expelled. Smuts was disappointed with the League awarding South-West Africa only a mandate status, as he had looked forward to formally incorporating the territory to South Africa.

In 1920 Smuts summoned Dr Hendrik van der Bijl to return to South Africa to establish an electrical power utility, ESCOM, to put South Africa on a sound industrial footing. This non-profit enterprise was hugely successful providing power at lower cost than any other power generation available. Van der Bijl’s next task was to establish a steel making industry, ISCOR. This was



also hugely successful providing low cost steel for local use as well as export. Smuts had invited Gutehoffnungshütte (Good Hope Works) of Oberhausen to investigate the feasibility of a large scale steelworks in Pretoria. In 1945 Smuts summoned Sir Basil Schonland to return to South Africa to establish the CSIR. Sir Basil also resumed his directorship of the Bernard Price Institute.

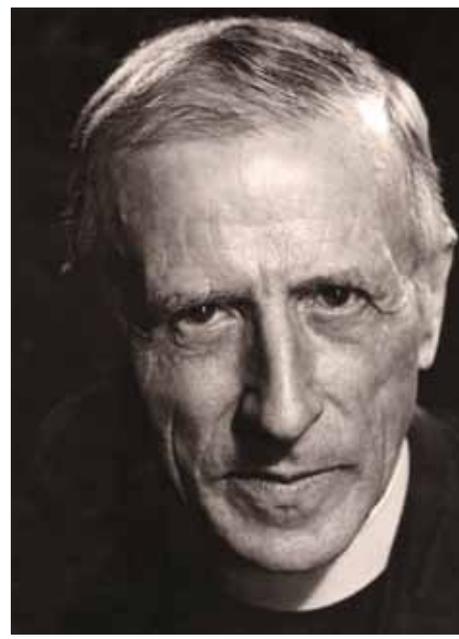
A World War erupted again in 1939 after a period sufficient to breed a new generation of soldiers. Smuts appointed Dr Hendrik van der Bijl as Director General of war supplies. This made a huge contribution to the war effort. The Peace treaty of WW2 took place in Paris on 10 February 1947.

Smuts was the only statesman to have been present at the signing of both peace treaties. An audacious plan was proposed by Churchill's private secretary Sir John Colville that Smuts be appointed as Prime Minister of the United Kingdom in the event of Churchill becoming incapacitated before the end of the war. Both Queen Mary and George VI warmed to the idea.

In July 1941, Smuts received a letter from King George VI congratulating him on rising to the rank of Field Marshal, and regretting that he was unable to hand him his baton in person. This task was delegated to Governor-General Sir Patrick Duncan.

In May 1945 Smuts represented South Africa in San Francisco at the drafting of the United Nations Charter. The UN currently has 193 member states and two observer states.

Other writers have also expressed ideas somewhat akin to Holism. Pierre Teilhard



Pierre Teilhard de Chardin (1881-1955)

de Chardin (1881-1955), a prolific albeit controversial writer is known for his book "The Phenomenon of Man". He wrote of an evolutionary process starting from subatomic particles going all the way up to the ultimate fulfilment of human consciousness. Giordano Bruno (1548-1600) took a pantheistic view of a divine consciousness pervading, and being part of every aspect of the universe. Bruno's ideas did not please everyone, resulting in his tragic end.

To include consciousness in an evolutionary process begs the question: what connection is there between consciousness and the material world? Astonishing mathematical research into this matter, posted in June 2017, has been done using algebraic topology to model a hyper dimensional link between brain and consciousness.

The Blue Brain Project is a Swiss national initiative which aims to create a digital

reconstruction of a brain by reverse-engineering brain circuitry. It is hoped that it will eventually shed light on the nature of consciousness. This was founded in 2005 by the Brain and Mind Institute of the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. It was found by modelling, that a brain functions in up to eleven dimensions, with a bizarre possibility that consciousness could be established in a quantum computer. Susan Schneider of the University of Connecticut and the Institute for Advanced Studies at Princeton has proposed that highly advanced forms of alien planet superintelligence could actually be post biological supercomputers. A fascinating 'must see' link is available at: <https://www.youtube.com/watch?v=3NYKC8mq4P0>

Using algebraic topology in a way that it has never been used before in neuroscience, a team from the Blue Brain Project has uncovered a universe of multi-dimensional geometrical structures and spaces within the networks of the brain.

When the researchers presented virtual (mathematical) brain tissue with a stimulus, cliques of progressively higher dimensions assembled momentarily to enclose high-dimensional holes that the researchers refer to as cavities.

Ran Levi of Aberdeen University commented:

"The appearance of high-dimensional cavities when the brain is processing information means that the neurons in the network react to stimuli in an extremely organized manner. It is as if the brain reacts to a stimulus by building then razing a tower of multi-dimensional blocks, starting with rods (1D), then planks (2D), then cubes (3D), and then

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more complex geometries with 4D, 5D, etc. The progression of activity through the brain resembles a multi-dimensional sandcastle that materializes out of the sand and then disintegrates."

Neuroscientist Henry Markram, director of Blue Brain Project and professor at the EPFL in Lausanne remarked:

"We found a world that we had never imagined; there are tens of millions of these objects even in a small speck of the brain, up through seven dimensions. In some networks, we even found structures with up to eleven dimensions."

Eleven dimensions is a magical number in string theory of particle physics, in the space-time topological manifolds of superstrings.

Neuroscience has also been struggling to find where the brain stores its memories. According to Markram: *"They may be 'hiding' in high-dimensional cavities."*

Poet Roy Campbell's "Minds full of holes" takes on new meaning here.

The mathematics of neuroscience topology appears fiendishly difficult.

One of the richest holistic treasures of the Earth is made up of the countries of Europe; each with its own rich cultural heritage of language, literature, art and music as well as social customs, costume, cuisine and architecture going back more than two millennia. Many of these countries are also at the forefront of all branches of science, engineering and industry. This holistic group of countries presents astonishing opportunities for academic study, research, tourism and leisure. Europe is globally one of the foremost countries for investment in research and development.



*Richard von Coudenhove-Kalergi
(1894-1972)*

A disturbing case of reverse-holism can be seen in the rapidly changing, and out of control demographics of Europe's migrant crisis. This grossly undocumented migration has resulted in an irreversible rise in demographic entropy. Some observers of the crisis regard this with horror, as the execution of a Coudenhove-Kalergi/Soros plan to replace the countries of Europe with a single one-language country with a larger interbred Afro-Eurasian population, which would wipe out all traces of more than two millennia of the richest cultures on Earth. It is claimed that the current Soros plan is to import a continuous stream of one million migrants per year, but this would have to be escalated to achieve a target migrant population of 150 million. Richard von Coudenhove-Kalergi (1894-1972) claimed that the new Afro-Eurasian population of Europe would have the appearance of the ancient Egyptians.

A more dire opinion holds that if the European countries cannot rouse themselves to civil war, then European civilisation will be extinguished in its entirety in the greatest genocide in history. We have here insidious evil on an unprecedented scale. It is interesting to note which European Heads of State have in recent years become recipients of the biennial Coudenhove-Kalergi awards.

An interesting connection can be found in the classic 1942 movie 'Casablanca' with Humphrey Bogart and Ingrid Bergman, which remains popular, and is still occasionally flighted on TV.

A high point in the movie takes place in Rick's 'Café Américaine', when Major Strasser leads his officers in the singing of 'Die Wacht am Rhein' which dates from the Franco-Prussian war.

Rick is irritated, but the hero of the piece, character Victor Laszlo is outraged, and seizes the opportunity to drown out the Germans, by rousing the crowd to sing the Marseillaise. Ilsa is near to panic as the dangerous situation unfolds but then swells with admiration of Laszlo's defiance.

A bizarre twist to the story comes with subtle hints that character Laszlo is based on Coudenhove-Kalergi, which makes him an even more evil villain than Strasser.

The singing duel can be seen at: <https://www.youtube.com/watch?v=HM-E2H1ChJM>

This movie was filmed in the US while war was raging in Europe. The impassioned tearful face of Madeleine Lebeau was not an act.

In an attempt to add credibility and dignity to the EU, Coudenhove-Kalergi proposed a simplified version of Beethoven's setting of Schiller's 'An die Freude' as the EU anthem.

Despite the huge popularity acquired by these words, after being incorporated into Beethoven's ninth symphony, Schiller dismissed them as being written in the bad taste of the time.

New Latin words have been written for the anthem as Schiller's abstract theme is totally unsuited as an anthem. Beethoven's ninth remains one of the greatest pieces of music ever written. A good example of a national anthem is the 'call to arms' of the French Marseillaise.

One may well ask how it can be possible for a highly developed First World civilisation to be overwhelmed by a Third World invasion. In 1887, Edinburgh history professor Alexander Tyler explained it this way:

*From bondage to spiritual faith;
From spiritual faith to great courage;
From courage to liberty;
From liberty to abundance;
From abundance to complacency;
From complacency to apathy;
From apathy to dependence;
From dependence back into bondage.*

Despite some people supposing that Smuts was entertaining heterodoxical ideas, Smuts remained a long time close friend of Ds Johan Reyneke, who delivered a stirring oration at Smuts's funeral. The well-known Methodist minister the Rev J.B. Webb also officiated at the funeral. The service took place in the Groote Kerk near Church Square in Pretoria on 15 September 1950. The writer of this article



*Jan Smuts Funeral at the Groote Kerk, Pretoria
15 September 1950*

was able, as a young schoolboy, to see from a high vantage point, the extensive military cortege moving slowly up Paul Kruger Street to the railway station.

In her pictorial biography of Smuts, Phyllis Scarnell Lean wrote:

His biographers are many; he has been portrayed as a soldier, statesman, scholar, philosopher, mystic, politician, and as a simple son of the veld. He played all these parts and homelier roles; a father romping with his children, an adored grandfather, a botanist who let the wild grasses grow over his doorstep.

When Smuts died, a book of poems by Emily Brontë was found beside his bed.

Emily expressed awareness of her own higher consciousness in the lines:

*... ever-present, phantom thing;
My slave, my comrade, and my king,
A slave, because I rule thee still;
Incline thee to my changeful will,
And make thy influence good or ill:
A comrade for by day and night
Thou art my intimate delight, -*

King George VI sent Mrs Smuts a cable saying: "...the force of his intellect has enriched the wisdom of the whole human race." **wn**



WATT? is a forum related specifically to the industrial and commercial electrical sector.

Do you have any burning questions, topical issues or points of interest about the electrical industry, from the perspective of a contractor, supplier or professional service provider? Submit your comments, thoughts, ideas, suggestions or questions for the attention of our industry experts, and these will be addressed in a future issue of the magazine. This is your forum, and we would like to hear from you!

WATT? is an opportunity for people on the ground to engage with each other and related professionals in an informative and friendly manner. This is a platform for you to discuss anything related to your particular sector, to highlight anything new, or to ask a specific question related to a technical topic or to engage in general industry issues. Please note that we will not be considering anything related to the domestic sector, such as residential wiring.

We hope that this section of the magazine not only becomes a regular feature, but that it is widely read and distributed among your peers. Remember, it can only become a success with the full participation of our readers! Send your burning questions to minx@saiee.org.za - subject 'WATT?'.

We look forward to hearing from you.
- Ed



QUESTION ONE

Why do transformers require cooling?

ANSWER ONE

Transformers required cooling because heat is generated from losses produced by the windings and connections. These losses can be classified as Copper loss (I^2R) and iron loss or core losses.

There are various other factors that contribute to heat generation, but the greatest by far is copper loss.

Excessive heat may lead to failure, but will certainly lead to a reduced life expectancy due to degradation of the insulation paper and breakdown of the insulation oil.

QUESTION TWO

How is loss generated heat dissipated?

ANSWER TWO

To reach thermal equilibrium, the heat produced must be equal to the heat being dissipated or removed. This can be achieved using external cooling systems to dissipate heat and to accelerate heat exchange.

The rating of the transformer and application will determine the type of external cooling to be applied to ensure maximum life expectancy. The most commonly used cooling system is known as ONAN (Oil Natural Air Natural). This type of cooling can be found on smaller to medium sized units, typical distribution application.

ONAN cooling relies on the natural convective flow. Warm oil rises allowing cooler oil to fill the vacancy left by the hot oil. The warm oil will rise via the radiators allowing dissipation in the atmosphere by conduction, convection and radiation in air. Radiators are attached to increase the dissipation surface area of the tank

In certain requirements, ONAN cooling is not efficient.

This process can be enhanced by forcing the air from the increased surface (radiators) with fans. This type of cooling is known as ONAF (Oil Natural Air Forced). ONAF still relies on natural convective flow.



By forcing the air from the radiators with the use of fans, faster and more effective cooling is achieved, and this allows the transformer to function within the permissible temperature limits at greater load.

In some requirements, physical limitations can govern the design of a transformer. In these cases, designing engineers will apply OFAF cooling (Oil Forced Air Forced).

In this application, insulation oil circulation is accelerated by applying mechanical force. Oil pumps force the insulation oil to flow in a closed loop system. This allows for a compact transformer and increased rate of cooling. This cooling method does not depend on natural convection, but displaces the heat from the origin, thus increasing the cooling rate.

In some special applications, such as certain types of furnace transformers, none of the above types of cooling will be efficient. In these instances, OFWF (Oil Forced Water Forced) cooling can be applied. Water ambient temperature is far less

than atmospheric air. Hot oil is pumped to a water heat exchanger via mechanical pumps, and water is applied to cool the heat exchanger tubes.

For very high rating transformers, oil paths can be pre-determined. This involves guiding cool insulation oil to flow an exact route and apply additional cooling where required. This form of cooling is known as ODAF (Oil Directed Air Forced).

During the winding process, windows are created and insulation oil is forced along a path between insulated conductors to ensure an increased heat transfer rate. Additional cooling can be applied where needed. This form of cooling does not require mechanical pumps, but fans are installed on the radiators.

A further cooling method worth discussing is ODWF (Oil Directed Water Forced). Essentially the same as ODAF, with the only difference that the oil is cooled by water instead of air. This cooling method still requires insulation oil to flow a pre-determined path to ensure that cooling is applied where required. **Wn**

November

Movers, shakers and history-makers

COMPILED BY | JANE BUISSON-STREET
FSAIEE | PMIITPSA | FMIITSPA

1 NOVEMBER

1954 The Industrial Development Engineering Associates Company began selling the Regency TR-1, the world's first commercial transistor radio. The TR-1 sold over 100,000 units, ushering in the commercial transistor industry.

2 NOVEMBER

1988 Robert Morris of Cornell University launched a self-replicating worm as part of a research project designed to determine the size of the early Internet. It was intended to count the number of computers that initiated connections when the worm was loaded onto them. However, due to a programming error, the "Morris Worm" began repeatedly infecting machines, clogging network traffic and causing machines to crash. Morris was dismissed from Cornell, sentenced to three years' probation and a \$10,000 fine.

3 NOVEMBER

1892 The first automatic telephone exchange, using the switching device invented by Almon B. Strowger (born 1839), was opened in LaPorte, Indiana, with about seventy-five subscribers. This early system used three keys that a subscriber pressed the appropriate number of times. In the UK, the very first Strowger exchange opened at Epsom in Surrey in 1912.

4 NOVEMBER

1845 While working in his laboratory, Michael Faraday hung a piece of heavy glass between the poles of an electro-magnet and then observed that the glass aligned itself across the lines of force of the magnet. He further experimented on many other substances with similar results. He named this phenomena diamagnetism. These investigations showed Faraday that magnetism was inherent within matter. This led to his lecture "Thoughts on Ray-vibrations" in

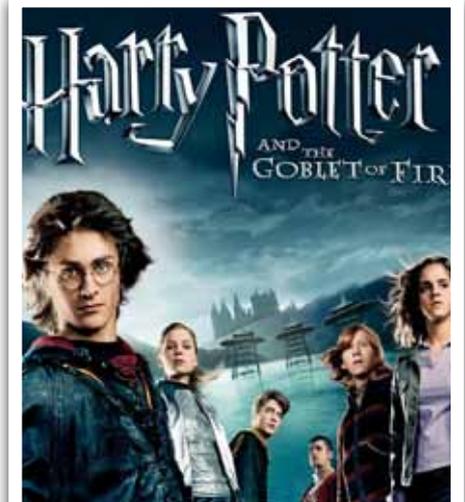
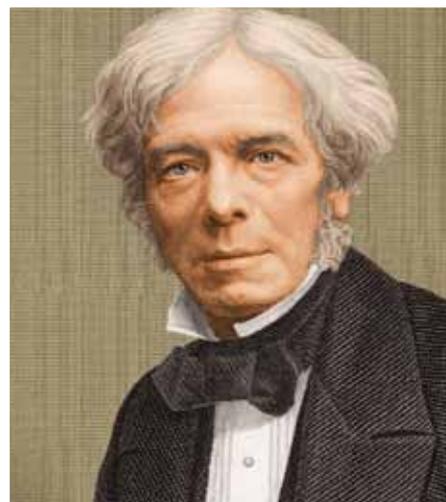
April 1846. This then formed the basis of his field theory of electro-magnetism.

5 NOVEMBER

1992 It was reported that Chemical evidence of 5000-year-old beer was found at Godin Tepe in the Zagros Mountains of Iran. Beer was the preferred fermented beverage of the ancient Sumerians. Trace elements of oxalate ion were found in an organic residue inside some grooves of a pottery vessel that had apparently been used for beer fermentation or storage. Calcium oxalate is a principal component of sediment that settles from barley beer.

6 NOVEMBER

2005 The fourth movie based on J.K. Rowling's books, "Harry Potter and the Goblet of Fire", premiered in London. It went on to become the most successful film of the year, earning almost US\$ 900 million.



7 NOVEMBER

1997 Chinese engineers completed the blocking of the Yangtze River, the first step towards building the Three Gorges Dam, the world's largest hydroelectric dam project.

8 NOVEMBER

1910 The first insect electrocution device (aka a bug zapper) was patented by William F. Frost of Spokane, Washington.

9 NOVEMBER

1965 The Northeast Blackout was a significant disruption in the supply of electricity on Tuesday, 9 November 1965, that affected parts of Ontario in Canada and Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Pennsylvania, and Vermont in the United States. Over 30 million people and 207,000 km² were left without electricity for up to 13 hours.

10 NOVEMBER

2001 Apple shipped the first iPod, the device that changed the course of both the music and technology industries. At the time, most “experts” could only focus on the fact that other devices cost less and may have had more impressive technical specs.

11 NOVEMBER

2015 Astronomers announced the discovery of V774104, the most distant object yet found in the solar system, a dwarf planet orbiting at three times the distance of Pluto.

12 NOVEMBER

1974 For the first time since 1833, a salmon was discovered in the River Thames, England. The 8-lb 4½-oz female was discovered entangled in the protective nets around West Thurrock power station. The find was so surprising that the fish was sent to the British Museum for positive identification; Victorian era sewage and factory waste had polluted the once thriving salmon river, and by 1849 all fish had disappeared.

13 NOVEMBER

2015 WT1190F, a temporary satellite of Earth, impacted just southeast of Sri Lanka. It is thought to have been space debris from the trans-lunar injection stage of the 1998 Lunar Prospector mission, and was first discovered on 18 February 2013 by the Catalina Sky Survey.

14 NOVEMBER

2015 A team of scientists from the United States and Europe are predicting that declining snowpacks on

mountain ranges could lead to Northern Hemisphere water shortages by the year 2060.

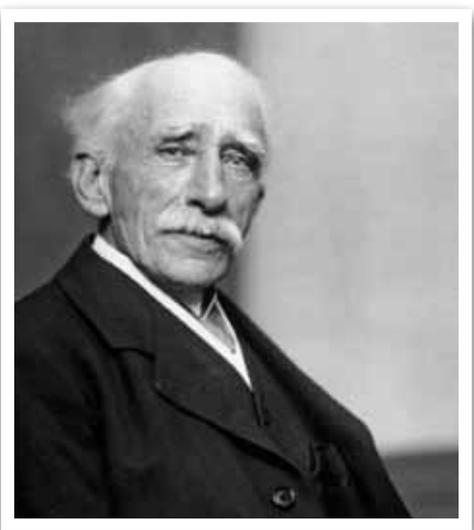
15 NOVEMBER

1932 The Walt Disney Art Studio was created and held its first meeting. This meeting was held in preparation for a new feature film and Disney had created the new art school to help train the animators in his specific style of animation. Because this was in the midst of the Great Depression, Disney had opened his doors to many talented individuals, who, if not for the economic drought, may have found themselves in very different jobs.

16 NOVEMBER

1904 John Ambrose Fleming applied for a US patent which he called the “oscillation valve”, the first example of the vacuum tube.

Vacuum tubes would form the basis of electronic technology for nearly 50 years until the development of the transistor. Fleming's invention has been described as one of the most important developments in the history of electronics.



NOVEMBER

continues from page 63

17 NOVEMBER

2017 The peak of the Leonids will occur tonight and early tomorrow morning. The Leonids are the Leonid Meteor Shower, an annual event that occurs when the Earth passes through the debris left by the comet Tempel-Tuttle. The shower is called Leonids because its radiant, or because of the point in the sky where the meteors seem to emerge from: in the constellation Leo. Anything up to 20 meteors an hour can be seen at the peak of its activity.

18 NOVEMBER

2010 American actor, George Clooney, was awarded the 2010 Ripple of Hope Award at the Robert F. Kennedy Centre for Justice and Human Rights, in recognition of his humanitarian work in Darfur and Haiti.

19 NOVEMBER

1996 The last section of the Confederation Bridge, crossing the

Northumberland Strait, Canada, was installed. The bridge is designed to allow a ship's clearance of 172 metres in width. The 12.9 km Confederation Bridge joins Borden-Carleton, Prince Edward Island and Cape Jourimain, New-Brunswick and is the longest bridge over ice-covered waters in the world.

The bridge construction began in Oct 1993, and was opened on 31 May 1997. It carries two lanes of traffic 24 hours a day, seven days a week and takes approximately 10 minutes to cross at normal travelling speeds. The bridge was built curved so that drivers could see the traffic in front of them, a design chosen to reduce accidents.

20 NOVEMBER

1929 Spanish surrealist painter Salvador Dalí's first solo exhibition opened at the Galerie Goemans. The exhibits consisted of two "old" oils (previously exhibited), plus twelve new ones.

21 NOVEMBER

2015 14-year old Lucas Etter solved a 3 x 3 Rubik's Cube in 4.90 seconds, beating the previous record of 5.25 seconds, and becoming the first person to solve it in under 5 seconds.

22 NOVEMBER

1928 Ravel's masterpiece, Boléro, premiered at the Paris Opéra. It was composed as a ballet, and was commissioned by Russian actress and dancer Ida Rubinstein. Boléro is Maurice Ravel's most famous musical composition.

23 NOVEMBER

2016 Astronomers announced the discovery of a near 1 2500 cubic kilometres subterranean deposit of ice on Mars. Researchers claim it can easily be used as a sustainable resource for a manned mission to the red planet.





24 NOVEMBER

2012 Gangnam Style became the most viewed YouTube, at the time, video surpassing 808 million views. As of 12 July 2017, there had been 2,896,607,902 views.

25 NOVEMBER

1961 The USS Enterprise, the first world's first nuclear powered aircraft, was commissioned. She was also the eighth United States naval vessel to bear the name. Enterprise was deactivated on 1 December 2012.

26 NOVEMBER

2012 NASA and Roscosmos announced that two veteran "spaceflyers", Scott Kelly and Mikhail Korniyenko, will carry out the first year-long mission to the International Space Station in 2015.

27 NOVEMBER

2015 It was announced that scientific studies confirm more than 90% of the world's glaciers are retreating, and many of the smaller ones —

like the alpine ice sheets of Glacier National Park in the U.S. — are rapidly disappearing.

On the other side of world, at Khumbu Glacier near Mount Everest in the Himalayas, expanding ponds are merging and forming larger bodies of water. This could threaten settlements downstream if they overflow. Thawing glaciers account for about 20% of the sea-level rise recorded in the past century, adding to the meltwater coming from polar ice caps and ice sheets.

28 NOVEMBER

1996 United States Patent 5,579,430 was granted to the Fraunhofer Institut in Germany for a "digital encoding process", the technology is used in MPEG Audio Layer III, more commonly known as MP3. MP3 technology paved the way for the digital music industry by creating a high-quality format that was compressible so that many songs could fit on the relatively small

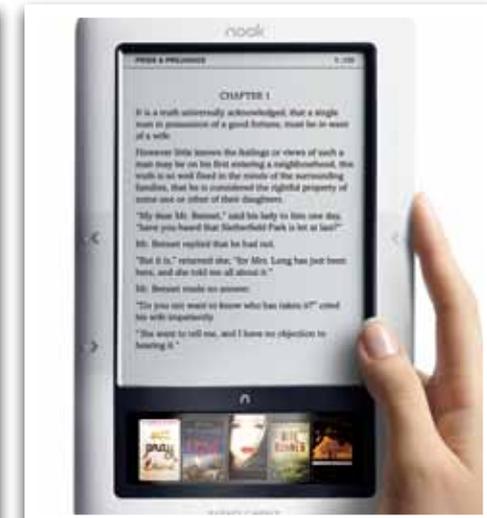
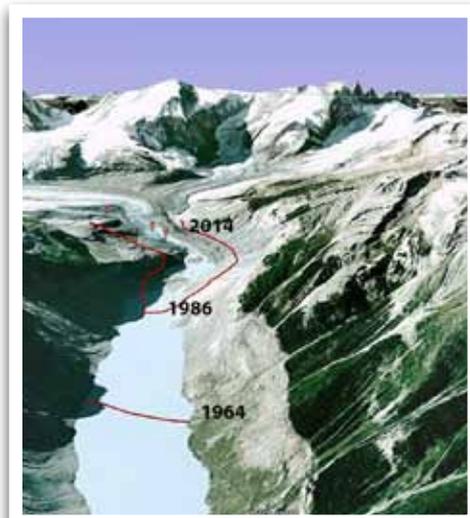
data storage devices of the time. Fraunhofer had started work on compressing music as far back as 1977, began work on what would become MP3 in 1987, and was awarded a patent in Germany in 1989.

29 NOVEMBER

2016 Scientists say that warm seas around Australia's Great Barrier Reef have killed two-thirds of a 700km stretch of coral in the past nine months.

30 NOVEMBER

2009 Book retailer Barnes and Noble released their first Nook e-reader to compete with the highly successful Amazon Kindle, released two years earlier. **Wn**



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