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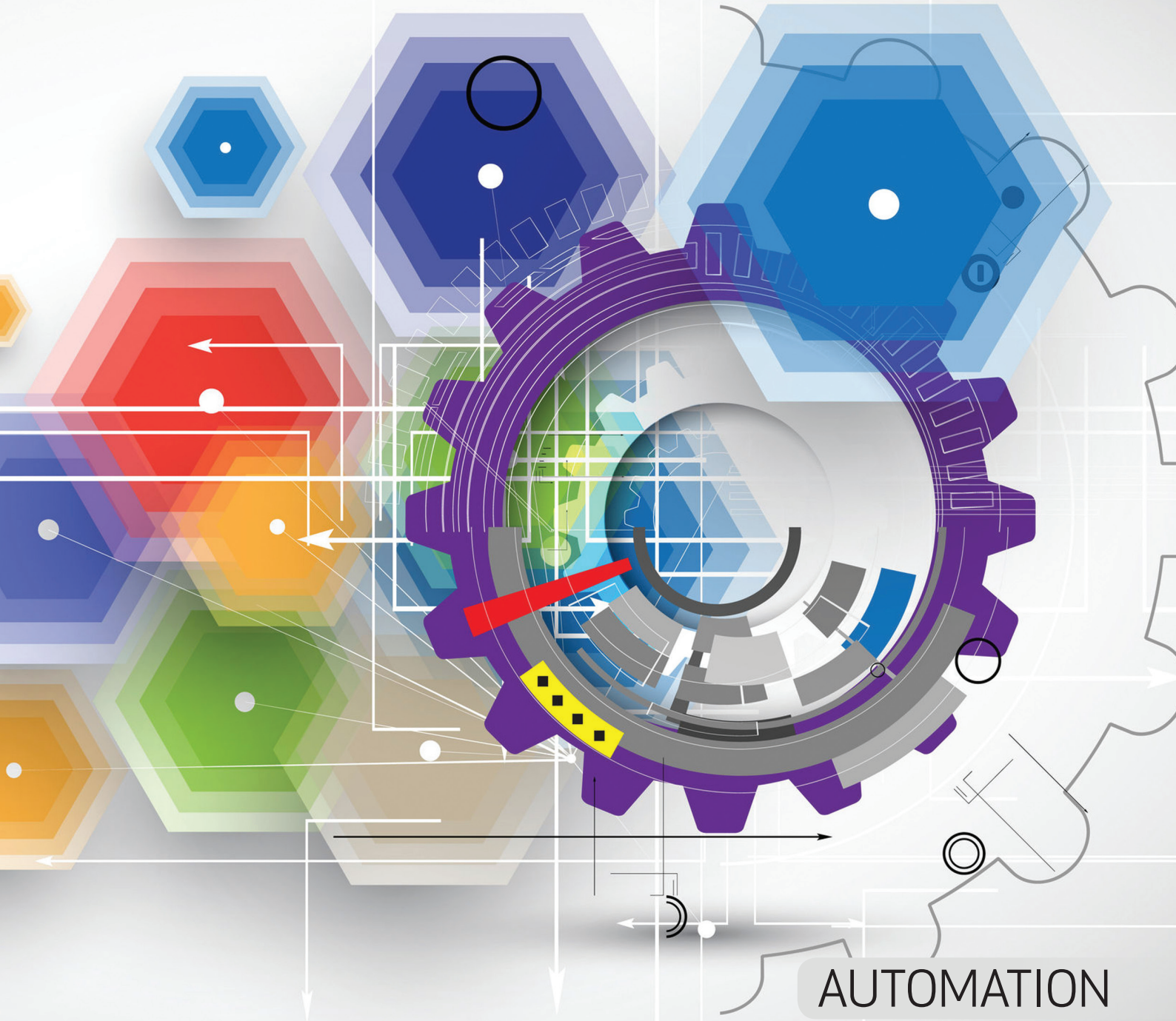
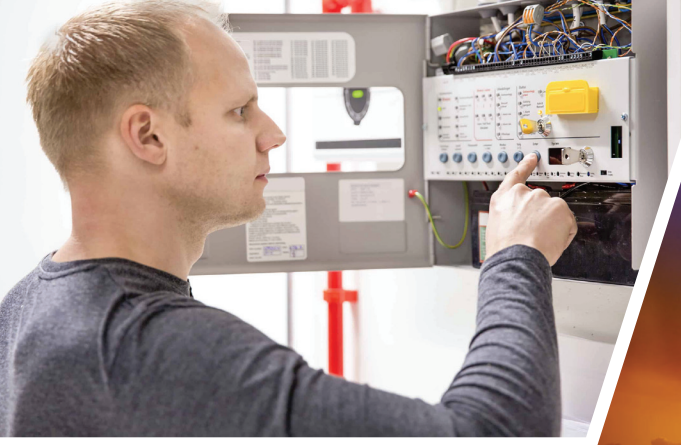


AUTOMATION

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | OCTOBER 2018



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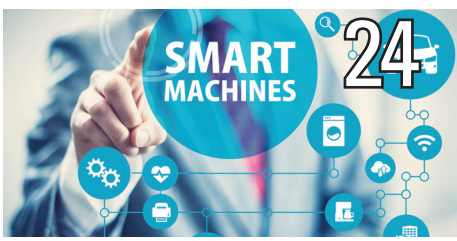
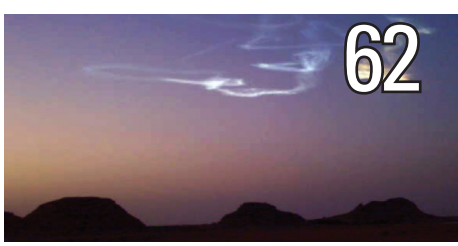
contents

FEATURES





GENERAL

REGULARS

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This October issue features automation, with the first feature article discussing Smart Machines. Powered by smart machines, the new industrial revolution is changing how machine builders design and manufacturers operate today and in the future. Read this paper on page 24.

We take a look at a case study "The Case for Drones in Energy", on page 34, in which the use of drones in the maintenance and fault finding of renewable energy generation plants promises a substantial return on investment. The pros and cons of this technology is discussed. You decide.

There's an awful lot of myth and misunderstanding about electromagnetic compatibility and interference. Keith Armstrong unpacks these in his article found on page 42.

Page 48 sports an article written by Dudley Basson, "Flow Batteries and Hydrogen", where he explains that reduction/oxidation (Redox) flow batteries show great promise for industrial scale electrical energy storage, which will enhance grid penetration of power from photovoltaic and wind turbine renewable energy.

In this issue, SAIEE Past President, Mike Crouch takes us on a trip "Down Memory Lane" on page 58 where he shares what he got up to as a student.

We are nearing our Annual Banquet and have a few seats still available. If you haven't booked your seat/table yet, contact Gerda (geyerg@saiee.org.za) today to avoid disappointment.

Here's the October issue, enjoy the read.

Minx

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The world is changing fast

DR HENDRI GELDENHUYS
2018 SAIEE PRESIDENT

It has been my pleasure to accompany Professor Ian Craig, Pretoria University's Head of Control Systems Group to deliver the annual Bernard Price Memorial Lecture at our Centers in Port Elizabeth, Cape Town, Durban and Johannesburg. His lecture "Automatic Control: The Hidden Technology that Modern Society cannot live without" was very well-received by our members.

Professor Craig is a Past President (2011-2014) of the International Federation of Automatic Control (IFAC) and still plays a vital role in the organisation. In his lecture, he explained how the practices of automated control play a crucial role in all facets of our lives. Every time we step onboard an aeroplane, it is in the hands of computerised controls. The theory behind automated control is equally valuable to address many of the financial, medical and other challenges that face our society. Control engineers, therefore, find jobs not only in engineering but finance, medical research and many more.

The SAIEE is your career partner in Electrical -, Electronic -, Communication- and Information Technology Engineering. We aspire to accompany you to become a competent engineering practitioner, and to register as Pr Eng or Pr Tech. Our aspiration goes further, to assist our members to be innovative entrepreneurs who will carry South Africa into a prosperous future. We are inundated with ever-increasing changes in new products and services that make society more efficient, and this is thanks to a few "brilliant minds". I ask myself, what did these inventors see and bring to the realm that others did not see? How do we acquire these skills to see opportunity and convert it into a profitable business? Can we breed more entrepreneurs in the South African environment and turn their efforts to accelerate the dearly needed economic growth we need?

I wish to leave you with a few thoughts: Engineers have the advantage of technical capability and competence; this gives us our edge in society and the economy. Control theory and many other engineering theoretical insights distinguish us as engineers. Does the pressure of engineering training divert and curtail our ability of thinking out-of-the-box? How do we break through this mould? Perhaps spending a year or two as a "second-hand salesman" may well serve engineers well, to learn the art of listening, understanding and defining customer needs and responding to customer's feelings?

Innovation often requires "ignorant questions" to experts that thought they understand and know "everything". Challenged by innocent-ignorant questions married with humbleness in response often lead to new insights. Such discussions need to take place on a platform where engagement is done as peers regardless of the "superior expertise" of some of the participants.

Defining new ideas is the easy part, the hard part is to execute and pursue the idea with tenacity to build the business with extreme levels of discipline to take us to the next level.

It is my aspiration that the SAIEE will develop the ability to build our members not only as engineering practitioners but also as entrepreneurial leaders in South Africa. Members who are passionate about the topic and who can assist the SAIEE in realising this aspiration, are invited to contact me.

H Geldenhuys | SAIEE President 2018
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Ticket sales open for DevConf 2019

Early Bird sales are now open for DevConf, South Africa's top forum for software developers. Now entering its fourth year, DevConf is again pioneering future thinking with an enhanced focus on inclusivity and exciting new opportunities for sponsors to make a big impact.

DevConf, a standing room only success since inception, will be staged at the River Club in Cape Town on 26 March 2019 and Vodacom World in Midrand on 28 March 2019. Delivering multiple tracks on the hottest global topics in enterprise software development, DevConf has become SA's go-to event for staying on top of global development trends, tools and techniques.

As the key local developer 'think forum', DevConf is also set to pioneer new levels of inclusivity in 2019. To overcome a 'cis white monoculture' in presentations, DevConf used an anonymous paper selection process for 2019. The 2019 event will also offer a selection of pronoun stickers which delegates can attach to their name tags. "This follows advances by the likes of Microsoft and Google at international events. We hope this will start a larger dialogue in our industry in South Africa," say organisers Robert MacLean and Candice Mesk.

In response to sponsor demand, DevConf 2019 will offer updated packages that allow sponsors to 'stand out and shine' with innovative displays and interactive spaces; as well as a range of live demos for practical, engaging learning.

DevConf traditionally attracts more than 700 delegates in Johannesburg and 500 in Cape Town, with tickets selling out quickly. Click here to book your seat now!
For more information, visit
www.devconf.co.za

Hudaco Industries appoints new Portfolio Executive

Ernie Smith
Portfolio Executive | Hudaco Industries

Hudaco Industries, a South African group specialising in the importation and distribution of high-quality branded automotive, industrial, and electrical consumable products, has appointed Ernie Smith as Portfolio Executive within the group. Smith will initially be responsible for leading suppliers BI and Bauer Geared Motor divisions, with additional divisions to be added to his portfolio in due course.

Smith has more than 25 years' industry experience. He has held various senior management and executive positions across the value chain in large multinational and South African listed companies. He has a degree in Industrial Engineering, and also completed a management development programme at Harvard Business School.

He held various positions at the latter over a decade, including that of Vice President for the Low Voltage business division for Southern Africa. Before joining Hudaco Industries, Smith was Operating Group Managing Director for several of Aveng's business units, which are currently being divested as part of a strategic review process.

Smith's short-term priories will be *"to ensure that BI and Bauer have clearly defined growth strategies, supported by an internal drive to better understand and serve our customers' needs and expectations. This will include looking at ways to expand our product offering and territorial coverage."*

It will also focus on leveraging synergies from the complementary product offering within the Hudaco group to adapt the total value proposition. *"I hope to use my depth and breadth of industry experience to guide both BI and Bauer to achieve their full potential,"* Smith concludes.

Cummins Announces Appointment of new Executive Managing Director for Africa and the Middle East

Cummins is pleased to announce the appointment of Mr Thierry Pimi as Executive Managing Director, Cummins Africa and Middle East Area Business Organization (ABO). Mr Pimi is currently Managing Director – Cummins Southern Africa Region and succeeds Mr Gino Butera.

Mr Pimi has led the Cummins South Africa business since 2016; bringing his proven financial, strategic, commercial and system controls experience gained across various industries. In the role, he has expanded the company's business model by aggressively pursuing growth opportunities in Zambia, Zimbabwe and Mozambique. He joined Cummins in 2009 in the Corporate Strategy team at the company headquarters in Columbus, the USA where he led several projects involving growth, profitability, divestiture and acquisitions.

Thierry Pimi said of his appointment: *"I am delighted to be leading the Africa Middle East Business at what is undoubtedly a pivotal moment in our Company history and for our region. I look forward to working with Tony Satterthwaite and our Company Senior Leaders to take Africa and Middle East ABO forward successfully."*

Mr Pimi is taking the reigns from Mr Gino Butera, who is relocating to the United States of America to assume the role of Vice President, Power Generation effective 1st September 2018.

The head offices for Cummins' Africa and Middle East Area Business Organization are in Johannesburg, South Africa, Dubai, UAE and Casablanca, Morocco.

Mr Thierry Pimi, Executive Managing Director, Cummins Africa and Middle East Area Business Organization

CESA Aon Awards creating legacies and honouring legends in the quest for engineering excellence

CESA/AON Award Winners.

In a night lit with glitz and glamour the who's who of the Built Environment, hosted by Consulting Engineers South Africa (CESA) and sponsored by Aon South Africa, celebrated excellence in engineering at the 2018 CESA Aon Engineering Excellence Awards - creating legacies and honouring legends. This year close to 50 submissions were received and in celebration of Nelson Mandela's Centenary year CESA expanded the Award's categories to include 'The Lifetime Industry Achievement Award', a discretionary award to recognise an individual who has contributed significantly to the development and promotion of the Consulting Engineering Industry in South Africa during their lifetime.

Chris Campbell, CESA CEO stated, *"It was befitting that we included this new category in the centenary year of one of the greatest legends of all time, Nelson Mandela. Engineers create legacies, each time you change the landscape you change history. Each time you plan, design, build, maintain and rehabilitate, you are creating a legacy for the next generation."*

WATTSUP

VUT Student Chapter visits ATNS

During August 2018, the SAIEE (South African Institute of Electrical Engineers) Student Chapter from the Vaal University of Technology (VUT), visited the Air Traffic & Navigation Services (ATNS) in Johannesburg with the aim of bridging the gap between the industry and students. They arrived mid-morning to a rapturous welcome from the ATNS team. The site visit began with a brief overview of ATNS. Aircraft don't just fly! Critical systems and procedures are crucial; therefore communication engineering plays a significant role. That is when electrical engineering takes over!

"The main aim of the site visit was to educate the electrical engineering students on the role ATNS play as engineers in the aviation industry," said Brian Mokoena, Chairperson SAIEE VUT Student Chapter. Aircraft rely heavily on communication for their flights. Without communication, planes are blind, and the lives of many passengers are at risk. The training of engineers to equip them with the skills of communication engineering is imperative and of paramount importance at ATNS.

The training facilities at ATNS engrave one with world-class knowledge and learning. Careers at ATNS are not limited to engineering, but they have opportunities in Air Traffic Control, Flow Management, Airspace Efficiency, Aeronautical Information Services, Air Traffic Management, Flight Procedure Design amongst many.

"As the VUT Student Chapter, we are proud to say that we learned a lot from ATNS. By representing the SAIEE, our wish is to foster a healthy relationship with the Air Traffic & Navigation Services" concluded Mokoena.

Top BBBEE Rating for Zest WEG Group is part of commitment to SA

Louis Meiring, Zest WEG Group CEO, and Juliano Saldanha Vargas, Logistics and Operations Director at Zest WEG Group with the certificate Zest WEG Electric (Pty) Ltd received for its Level 1 BBBEE rating.

Steadily integrating its continuous improvement efforts alongside the transformation of its business, the Zest WEG Group recently achieved Level 1 status in terms of Broad-based Black Economic Empowerment (BBBEE) ratings.

A subsidiary of the Brazil-based multinational WEG, the Zest WEG Group is over 51.6% black-owned, including a 32.1% stake by black women, and was ranked as Level 2 last year.

"Our real success here has been to ingrain our commitment to South Africa and to transformation in the everyday activities and culture of the business," says Zest WEG Group Chief Executive Officer Louis Meiring. *"Our empowerment journey is not an annual tick-box exercise, but rather is driven by every staff member working to build local capacity, people and excellence."*

He emphasises that the business model has evolved to engage all employees in maintaining the group's focus on quality and transformation.

Reaching this pinnacle BBBEE rating has been the culmination of various efforts, according to Zest WEG Group Operations Director Juliano Vargas, and is just one indication of the investment that the group is making in the country's economy and society.

"We continue to invest in local manufacturing and are improving our facilities to achieve high levels of quality and productivity," says Vargas. "This also means developing the skills necessary and increasing our knowledge base in the latest technologies related to our production requirements."

From its position as an ISO 9001-listed business, Zest WEG Group was recently one of the first to upgrade to ISO 9001-2015, making it one of only 112 companies out of 2,200 South African firms with ISO 9001 certification to reach this next level. The group has also recently invested heavily in its Heidelberg transformer manufacturing plant, where it operates one of the country's leading test laboratories for transformers.

Smartphone-tech pioneer awarded honorary doctorate by the University of Pretoria

Prof Ben Shneiderman, a Professor of Computer Science at the University of Maryland and a world leader in the visualisation of big data sets, was awarded an honorary doctorate by the University of Pretoria's Faculty of Engineering, Built Environment and Information Technology, during its Spring graduation ceremony.

Prof Shneiderman is one of the most influential human-computer interaction researchers in the world. His 1986 list of Eight Golden Rules of Interface Design is still frequently taught in human-computer interaction courses. His book, Designing the User Interface, now in its 6th edition (2016), has been translated into eight languages, and is used worldwide in human-computer interaction courses.

His work contributed to a large degree to graphical user interfaces that we still currently use on our computers and mobile devices. He was instrumental in developing the selectable link of the World Wide Web, and the small touchscreen keyboards that we use on our smartphones and other devices.

Prof Shneiderman was listed among the top 1000 creative people in the USA in the book, 1000: Richard Wurman's Who's Really Who (2002).

Prof Ben Shneiderman

WATTSUP

Cummins Scoops Skills Development and Learnership Award at 2018 Africa Employee Engagement Awards

From left: Dr Raymond Patel, CEO MERSETA and Ms Vathiswa Mkatshane, Cummins Southern Africa's Skills Development Facilitator.

Cummins South Africa is the proud recipient of the Skills Development and Learnership Award at the recently held inaugural Africa-wide 2018 Africa Employee Engagement Awards at the Hyatt Hotel in Johannesburg, South Africa.

The awards ceremony, attracting some 150-guests, was hosted by N2Growth Africa and sponsored by IE Business School, the international executive education school based in Spain.

Drawing some 300 competitors within the Manufacturing, Engineering and Related Services Sectors, the awards focused on employee engagement within the Diversity and Inclusion, Rewards and Recognition, Skills Development and Sustainable Future segments of the workplace.

Eleven category winners and 18 highly commended entries were adjudicated, judged and awarded by an independent judging panel.

ATNS to Host Seventh Annual Innovation Summit

The Air Traffic Navigation Services (ATNS), will once again host the AVI Afrique Innovation Summit in Gauteng, South Africa in October of this year.

"The Aviation industry is largely enhanced and advanced through innovation. ATNS as an organisation strategically focuses on encouraging and supporting innovators in the industry, and actively seeks to provide a platform for such entrepreneurs, through this summit and its AVI Awards contest," said ATNS CEO, Thabani Mthiyane.

With the theme of this year's summit focused on "Breaking barriers in the aviation industry through innovation", the summit seeks to explore how the industry deals with the emergence of incidental and real-life barriers that may lead to a need for realignment and restructuring – from an Air Navigation Services perspective.

It is no secret that like any industry, new challenges are constantly arising, due to unexpected developments. *"Sudden changes in our industry can certainly be overwhelming and we need to always be a step ahead of the curve, developing, creating and innovating for the future of aviation,"* noted Mthiyane.

In an IATA (International Air Transport Association) report titled – The Future of the Airline Industry 2035 – various drivers of change are detailed and include terrorism, urbanisation and growth of megacities, geo-political instability, cybersecurity, water and food security – to name but a few.

The report talks to the fact that the aviation industry seems to be reacting to new technologies rather than leading the charge.

So, while great strides have been made by putting in place recommended standards and practices to encourage and promote innovation within the aviation fraternity, the industry needs to employ continuous innovative means to evolve with the changing times, while remaining inherently safety-conscious.

Fluke's Thermal Multimeter 2-in-1 combo test tool

A full-featured digital multimeter PLUS thermal imager in one tool for faster troubleshooting

Thermal imagers are invaluable to help quickly troubleshoot electrical equipment, panels, and transformers but electricians and maintenance technicians don't often have access to one when they need it. Comtest is offering the Fluke 279 FC TRMS Thermal Multimeter, the first test tool to integrate a full-featured true RMS (TRMS) digital multimeter (DMM) with a thermal camera, in one device.

The 279 FC allows technicians to check for hot spots in fuses, wires, insulators, connectors, splices, and switches with the imager and then troubleshoot and analyze issues with the DMM. This combination of two powerful test tools into one, means electricians and technicians need to carry fewer troubleshooting tools.

The thermal multimeter features 15 electrical measurement functions including ac/dc voltage, resistance, continuity, capacitance, diode test, min/max, and frequency. The optional iFlex® clamp can wrap around conductors and wires in tight, hard-to-reach spaces and expands its measurement capabilities to include ac current up to 2500 A. The 3.5 inch (8.89 cm) full-colour LCD screen ensures clear images.

Alstom signs MoU with Ukrainian Railways

Alstom and Ukrainian Railways (UZ) have signed a Memorandum of Understanding officialising cooperation for the provision and maintenance of electric locomotives. The MoU was recently signed by Yevgen Kravtsov, Acting Chairman of the Board of Ukrainian Railways, and Henri Poupart-Lafarge, Alstom's Chairman & CEO, during the InnoTrans 2018 railway trade show in Berlin.

The strategic priority of UZ is the renovation of its electric locomotive fleet. The total requirements of UZ over the next 10 years cover 495 locomotives, including freight locomotives of different voltages (25kV, 3kV, and dual-voltage) and dual-voltage passenger locomotives, as well as associated services and maintenance for up to 25 years. It also encompasses the homologation of the product in Ukraine and the provision of all relevant documentation by Alstom.

"I am very pleased to be officialising this cooperation with Ukrainian Railways today. Alstom is present in over 60 countries and we are proud to count Ukraine among them. Wherever we are, we adapt to local conditions and propose suitable solutions to our customers. We see the high potential of the Ukrainian market, and we would be proud to contribute to the modernisation of the country's railway infrastructure and its further integration within the broader European railway market," said Henri Poupart-Lafarge, Chairman and CEO of Alstom.

"Alstom is one of the world's leading rail transport manufacturers. I am pleased with the fact that today's memorandum is a starting point for our cooperation with the French company. Our strategic goal is to renew our fleet of locomotives. As we already have a strategic partner in the supply of diesel locomotives, we are actively exploring the possibilities for the effective cooperation on the renewal of the electric locomotive fleet. Almost 47% of Ukraine's railways have been electrified, but the goal is to increase the number of electrified areas up to 54% within two years. Cooperation with Alstom is also very important for us because the company has considerable experience in the manufacture of 1520mm gauge electric locomotives. Moreover, the possibility of maximum localization at Ukrainian enterprises is the essential condition in the cooperation with Alstom", said Yevgen Kravtsov, Acting CEO of Ukrainian Railways.

MoU signing

Following preliminary meetings held in April this year between Alstom's management and Ukrainian authorities, Alstom has opened a representative office in the country.

Ultrasonic Sensors for Switching and Measuring

Longer operating ranges and broader areas of application are only two of the features offered by the Leuze's Leuze HTU 418B and Leuze DMU 418B ultrasonic sensors. Suitable for switching and measuring applications, the devices have an operating range of up to 1 300 mm.

These fully metal-enclosed ultrasonic sensors offer protection to Class IP 67 and are available in either cylindrical M18 or M30 housings. The compact housing allows the sensors to be installed in locations where there are space constraints, and this offers end-users greater flexibility.

Both series were equipped with an improved teach function: two push buttons for defining two independent switching points simplify setup and increase flexibility when using the sensors. Device types with an IO-Link interface ensure the intelligent, simple and user-friendly connection and activation of the sensors.

Temperature compensation prevents measurement errors that could be caused by various environmental conditions. Four operating modes, e.g. for changing from synchronous to multiplex operation, offer high flexibility during use.

The ultrasonic sensors operate using a switching behaviour that is independent on the surface of the sound-reflecting materials. They are available with various sound lobes. The narrow sound lobes permit the detection of the smallest of objects or the detection through the smallest of apertures at short response times.

Countapulse Controls is the official distributor for Leuze sensors in southern Africa and is able to offer technical support including assistance in selection of the most appropriate sensors for any given application.

From left: Andrada Manu, National Product Manager at Mustek Limited and Malvin Naicker, Sales Director for Africa at Eaton South Africa.

Eaton appoints Mustek Limited as Power Quality Portfolio distributor for Sub-Saharan Africa

Power management company Eaton South Africa has appointed Mustek Limited as a distributor for its Power Quality Portfolio of products in Sub-Saharan Africa, with effect from 1 September 2018. The portfolio includes Eaton's 5E, 3, 5 and 9 Series Uninterruptible Power Supplies (UPSs) up to and including 40kVA as well as its Ellipse Pro and Ellipse Eco UPSs, Power Distribution Units (PDUs), as well as its racks and cooling products.

Eaton manufactures, sells and supports unified technology solutions incorporating its UPS products, enclosures, power distribution, advanced power management and reliability techniques, as well as its world-class services.

"Appointing Mustek Limited as a distributor in Sub-Saharan Africa allows us to expand our IT distribution footprint and reach our customers more effectively," explains Malvin Naicker, Sales Director for Africa at Eaton South Africa. *"Mustek Limited has a far-reaching reseller network in the region and collaborating with them to distribute Eaton's Power Quality Portfolio will help us gaining a competitive edge in the region."*

"With business growth comes an increased demand for business continuity, and as IT environments increase their reliance on business-critical applications, they expect market-leading solutions and the peace of mind that comes with robust back-up systems to ensure that business efficiency and productivity," says Andrada Manu, National Product Manager at Mustek Limited. *"Adding Eaton's range of UPSs and PDUs and its rack and cooling products positions Mustek well to respond positively to their needs and expectations."*

Schletter Group reorganise management

Florian Roos
Chief Executive Officer

Dr Cedrik Zapfe
Chief Technology Officer

Oliver Renzow
Chief Operating Officer

The Schletter Group recently presented their new management team: With immediate effect, Florian Roos (CEO), Cedrik Zapfe (CTO) and Oliver Renzow (COO) will be at the helm of the internationally active group of companies. The reorganisation puts the succession plan for Tom Graf into effect, who has left the company following the successful restructuring.

"After our successful turnaround, it is now time to look to the future again," the shareholder commented. *"We would like to thank Tom Graf for his accomplishments and look forward to opening a new chapter with Florian Roos as our new CEO."* Roos had established the successful Asian segment of the Schletter Group, which he has been managing for six years. *"Mr Roos is thus excellently qualified for his future responsibilities,"* the shareholder said. *"He represents both continuity and innovation at the same time."*

The two other members of the new management team have long-lasting ties to Schletter as well: Zapfe has been head of development at the Schletter Group for 10 years and had already been appointed to the management in August. Renzow has been the CFO throughout the entire restructuring process. *"With this new line-up, we have a powerful team that is very familiar with the company and its strengths,"* the shareholder said. *"That puts us on a very firm footing for the future."*

The Schletter Group plans to focus specifically on product development and further opening up key international markets.

Following the acquisition by the new shareholder in July, business of the Group has continued to develop favourably.

World's Smallest Absolute Multi-turn Encoder

Modern industrial applications demand innovative designs featuring high performance, precise information and smaller component footprints.

Instrotech is offering the SCANCON world's smallest absolute multi-turn encoder with SSI interface. Based on new advanced electronics and mechanics, this high quality, technically sophisticated encoder was developed by Scancon's engineering team and represents the first step into a new world of automation possibilities.

Scancon designed this encoder to provide a compact, high performance solution for motion control applications where space is critical and features a 24mm diameter size with multi-turn SSI capability. No other encoder on the market offers this solution.

WATTSUP

Engineers Without Border - South Africa

On the 15th September 2018, SAIEE Council member, Monde Soni took part in an initiative that was driven by Engineers Without Borders South Africa (EWB-SA).

"Engineers Without Borders South Africa is a non-profit company setting out to reshape South Africa's engineering sector as a place where people can live their passion, unfold their potential and work with compassion. Our membership base consists of approximately 1500 student and professional members with a wide variety of engineering backgrounds. We work to provide our ten student chapters with the resources they need to impact their communities in various forms", EWB-SA highlighted.

They added that *"we improve the quality of the engineering education experience by providing a platform that teaches them to harness their passions into tangible actions, grow a solid network and learn to use it and work on community-based projects in diverse engineering skills-based teams".*

EWB-SA explained that *"as part of our mandate to empower engineers to empower communities, EWB-SA hosts an annual national social impact design challenge for all ten universities that affords our members the opportunity to apply a human-centric approach to solving complex issues in our society. This year, we partnered with Aurecon and Grassroot to offer design thinking workshops to our chapters, and tackle some of the issues faced by the Mzondi informal settlement located between Ivory Park (CoJ) and Tembisa (Ekurhuleni), and Mnadini, a township in the city of Roodepoort situated west of Tshepisong. The challenge took place in Cape Town, Durban and Gauteng".*

"With the guidance of Grassroot and tools taught to the chapters by Aurecon, we engaged with the communities to better understand their challenges. The information gathered was used to develop a design brief that considered all the challenges that the communities brought forward. It all came together on the 15th of September 2018 at the Aurecon offices in Pretoria, when teams of young, passionate engineering professionals and students guided by seasoned engineers unpacked the issues to form sustainable solutions for each community", EWB-SA.

EWB-SA concluded by saying that, *"We will be awarding the team with the best solution the opportunity to develop it further with professional mentorship. All the solutions generated in the session will be packaged and given back to the community. EWB-SA aims to continue providing a platform wherein budding young engineers and seasoned professionals can utilise their skills to improve their understanding of how to solve challenges in their communities".*

SAIEE was requested to take part in this event by availing professionals to give coaching to the young engineers and students in the process of designing solutions that are practically implementable. To this end, Monde contributed to the group that dealt with electricity-related challenges. Monde concludes that it was quite interesting to listen to the proposals of those young stars!

DEHN AFRICA brings you the dream team!

From left: Julienne Puttkammer, Tatenda Gora, Hano Oelofse, Stefan Nortje, Jacques Keyser, Ivan Grobbelaar

The DEHN Africa Technical Team offers a range of technical support in lightning and surge protection products. They also undertake site assessments and produce designs of lightning protection systems.

In achieving their goal, the Technical Team, which has been rounded out with recent appointments of additional resources, has gathered together a select group of impassioned engineers who offer a valuable combined skills-set.

Tatenda Gora, Sales Engineer, says, *"DEHN Africa offers products within a very niche engineering sector, and so the technical support and engineering services that we offer, including consulting, is critical. The DEHN Technical Team is responsible for providing engineering and technical support in lightning protection, surge protection, earthing and safety equipment. This includes designs, customer support and product specification. Through this suite of service offerings, we add value to the day-to-day activities of the company."*

"The team has been in existence since 2014, when we realised that there was a need for technical support in the lightning and surge protection products that DEHN offers. After this, the need for site assessments and designs of lightning protection systems arose, and the team began to grow from there."

The team is headed up by Technical Director Hano Oelofse, assisted by Ivan Grobbelaar, Senior Engineer.

Mark Wilson resigns as Chairman of ACTOM

Mark Wilson, who has served as Chairman of ACTOM since 2008, resigned from this position at the end of August 2018 for personal reasons.

In announcing Wilson's resignation, Group CEO Mervyn Naidoo said Andries Mthethwa, the group's Deputy Chairman, will serve as Acting Chairman until Wilson's successor is appointed. Wilson will continue to serve as a strategic advisor to ACTOM's senior management and remains involved as a shareholder.

Paying tribute to Wilson's legacy as Group CEO and Chairman, Naidoo said: *"Mark was instrumental in the creation of ACTOM in its present form. It remains an absolutely phenomenal business, despite the prevailing challenging economic environment. The entrepreneurial culture and management philosophy that has been developed in ACTOM is unique in South Africa, and is a model that has achieved superb outcomes for all stakeholders over the years."*

"Mark has nurtured and developed many Divisional CEO's in the group, including myself, during his tenure," he added.

WATTSUP

Voltex Management Awards of Excellence

Voltex (Pty) Ltd, South Africa's largest electrical and lighting distributor prides itself on setting the benchmark for service and performance excellence in the industry. To achieve this standard requires a purposeful and determined pursuit of going above and beyond expectations.

The Voltex Group recognises the contribution made by individuals, business units and branches in achieving exceptional standards of excellence. These efforts were acknowledged and celebrated at the annual Voltex Management awards, held on Tuesday the 4th of September at their head office in Senderwood.

Voltex Management congratulates all of the well-deserved winners. *"I would hasten to add that we regard all of the Voltex team as winners in all they do to make our Group a better one"* said Stan Green, CEO of Bidvest Electrical after presenting the awards.

Ventilation Fan Test Column At Marthinusen & Coutts A First On The Copperbelt

M&C Zambia test technicians conducting a test with the facility's newly installed mine ventilation fan test column.

Access to a ventilation fan performance test column installed at Marthinusen & Coutts Zambia, a division of ACTOM (Pty) Ltd, offers a major advantage to mines on the Zambian and DRC Copperbelt.

Significantly, this is the only fan test column in the region and was commissioned at the Kitwe based facility in the second quarter of 2018. The custom engineered test column will facilitate verification of ventilation fan performance following repair work prior to installation.

According to Eugene Lottering, General Manager at Marthinusen & Coutts Zambia, the test column will ensure that ventilation fans are tested and validated to the requisite parameters prior to being installed.

The test column has been designed to perform tests in accordance with the current BS ISO 5801:2007 standard and equipped with common test airways with a 1 016 mm diameter. Interchangeable conical inlet throats with diameters of 766 mm and 1 016 mm allow underground operating conditions to be simulated with ease.

Lottering says that while subjecting the ventilation fan to operating conditions, it is possible to test various critical parameters including static pressure, air flow, shaft power and speed, vibration and kW rating as well as overall total efficiency. *"The test facility allows for accurate reporting data to be produced which provides assurance for customers that the ventilation fan will meet the operating criteria,"* he says.

Marthinusen & Coutts Zambia has a selection of OEM reference fans should it be necessary to test these on the column for verification purposes.

Recently, Marthinusen & Coutts Zambia conducted a comparative test for a customer on ventilation fan installations. Lottering says that interestingly the competitor installation only achieved 64% on a 45 kW fan and 50% on a 37 kW fan, while the Marthinusen & Coutts fans both achieved an 80% rating.

Marthinusen & Coutts has also established a working alliance for the service and repair of main and auxiliary fans with TLT ACTOM. This collaboration brings together the expertise of a fan technology specialist and the experience of a leading electrical rotating service and repair operator.

EM launches hagercad software for low-voltage distribution planning

The new hagercad software from Hager for planning and configuration of low-voltage switchgear is now available locally from ElectroMechanica (EM), Hager's official distributor in South Africa.

The software package is aimed at the design and encryption of distribution boards up to 4000 A. *"It provides a real alternative to classical design software,"* Divan Lerm, EM Technical Sales Specialist, comments.

"A complete and innovative tool, hagercad is a real project manager that ensures you never miss a thing. Even as early as project creation, you'll see just how effective it is. And once you've reached mid-planning phase, you'll find the numerous practical, logically-linked functions absolutely indispensable.

"With hagercad, you do not need to have the catalogue with you. A simple click of a button, and you can see more information on any product, including dimensions and item-specific technical data," Lerm explains.

A major feature is the automatic circuit diagram function. This means that hagercad can generate multi-line or single-line plans with zero fuss, for various applications such as lighting, air-conditioning, KNX, or any customer-specific solutions. *"What functions do you want to implement, and where? All you need to do is implement your specific requirements,"* Lerm points out.

Whether you are planning or working on enclosure calculations, hagercad is fast, accurate, and logical. As soon as you commence with the layout plan, the system proposes only enclosures that the devices will fit into.

"Atoms Empowering Africa" Youth Video Competition Winners Announced

The public and independent jury have cast their votes and the winners of the "Atoms Empowering Africa" Youth Video Competition have officially been selected. Four teams from South Africa, Nigeria and Tanzania received the highest number of votes from both the jury and the public.

The winning teams will receive an all-expenses paid trip to Russia and the contestants of the top seven shortlisted videos will all receive power banks and diplomas to thank them for their exceptional work and valiant efforts.

The highest number of votes were received by three teams: two South African teams and one Tanzanian team. The top-three videos were determined based on number of comments left by Facebook users. The independent jury also awarded their special decision to a contestant from Nigeria due to exceptional effort and great attention to technical detail shown in the video.

The award ceremony will take place on the 16th of October 2018 in Johannesburg, South Africa. All winning teams and their supporters are invited. During the ceremony there will be screening of winners' videos and a lecture about benefits of nuclear energy. The organizers will include the winners from outside South Africa into the ceremony via video link.

The dates of the trip have been shifted to late November 2018 to accommodate all participants of the trip and avoid interference with planned events and university exams.

The list of winners who are awarded first prize – all-expenses paid trip to Russia:

- Winner #1 - video *"How would you explain the benefits of the peaceful atom to your fellow Africans?"* by Veronica Kgabisang Gouws, Koketso Kgorinyane, Naomi Mokhine from South Africa.
- Winner #2 – video *"How would you explain the benefits of the peaceful atom to your fellow Africans"* by Harriet Mphaho and Thabo Mametja from South Africa.
- Winner #3 – video *"Going Nuclear : Africa's Energy Future"* by Sophia Abeid, George Davis Bilali and Suzane Constantine Mumba from Tanzania.
- Special decision winner – video *"Sustainable development goals"* by Ugenyi Igbokwe from Nigeria.

List of winners who are awarded with a diploma and a second prize of a powerbank:

- Video: *"Peaceful Atom for Africa: Who & Why"* by Irvine Lumumba and Grace Malele from Kenya.
- Video *"Nuclear Energy For A Greater Africa"* by David Mwaka, Isaac Kiprotich and Donald Kemboi from Kenya.
- Video *"Atoms Empowering Africa By Anaeli And Clement"* by Clement Masele and Anaeli O. Kisanga from Tanzania.

JURY COMMENTS:

"As for me, videos are excellent. I was impressed by their powerful nuclear message. They totally deserve full marks. To my mind, everyone should watch this", – commented the jury member Gaopalelwe Santswere, AYGN President.

"I am amazed by the quality and comprehensibility of all the videos shortlisted and have given the highest scores to six of seven of them, – said jury member Dr. Anthonie Cilliers SAN-NEST National Coordinator.

"Very well put together - the presenters are energetic and make the viewer want to learn more about atomic energy", - noted jury member Minx Avrabos, Managing Editor of the **watt**now magazine.

Mr. Dmitry Shornikov, CEO of Rosatom Central and Southern Africa comments: *"We at Rosatom view education and youth development as a priority. "Atom Empowering Africa" Video Competition is running for the 4th year already. It is aimed at encouraging students to do their own research into various nuclear applications for peaceful use.*

We are happy to support youth empowerment through this competition and hope it allows more young people from Sub-Saharan African to research how atomic technologies can benefit all Africans."

ABOUT THE COMPETITION:

The video competition ran from June to September 2018, young people were invited to research and to make their videos about various nuclear technologies, their applications and benefits for Africa, post them online and take a chance to win educative week-long journey to Russian nuclear facilities and landmarks.

More than 30 students from Sub-Saharan Africa took part in the contest ran by Rosatom in cooperation with African Young Generation in Nuclear (AYGN), South African Institute of Electrical Engineers (SAIEE) and South African Network for Nuclear Education Science and Technology (SAN NEST).

Members of these organizations comprised jury panel and cast their votes then allowing the public to decide the winners. The jury chose seven videos that were published on participants' personal Facebook pages and collected the biggest number of "likes".

Jury's choice was based on the number of initial "likes" each video received and such criteria as creativity, comprehensibility and impact.

Teams from Tanzania, Kenya, South Africa and Nigeria are among the shortlisted. wn

New revolutionary wind power technology

As an organisation that focuses on finding solutions to the world's changing resources and energy challenges, WorleyParsons continuously seeks to develop and encourage innovative ideas, refine those ideas and take them to market.

With the drive towards renewable energy gaining pace, the project delivery company is harnessing its deep insights of energy markets and understanding of new energy technologies, and collaborating with innovators in this sector. One such innovator is Brayfoil Technologies which has developed a groundbreaking morphing wing that represents a first in aerodynamics.

The Brayfoil is an auto-setting morphing wing that has the potential to make a significant impact on the reduction of fossil fuel usage and the consequent reduction of atmospheric pollution and global warming. The revolutionary wing can reverse lift from one surface to the other, and can become any section required by the aeronautic designer by a simple actuation method. Whilst primarily a solution that expands the operating envelope on aircraft with vastly reduced cost and complexity from current technology, Brayfoil is focusing on the renewable energy field as its first area of development.

WorleyParsons is supplying design support in the form of engineering drawings and engineering analysis for the Brayfoil turbine prototype which uses a flexible wing in a vertical axis configuration to create optimal lift at low rotational speeds, enabling the use of large, dynamically adjustable wing surface areas. Its strength lies in its simplicity as the seamless wing works without hinges, joints, panel sections or flaps.

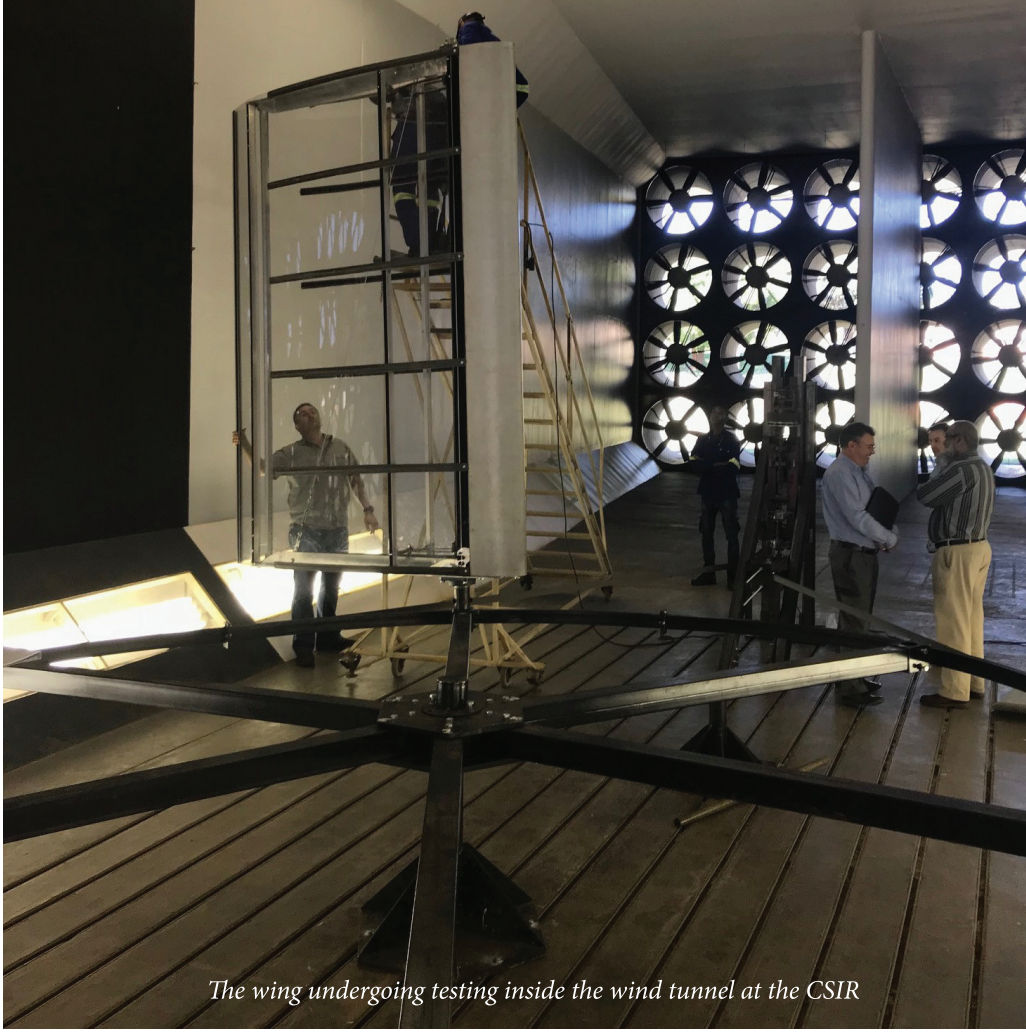
The world-wide patented Brayfoil is the invention of Robert Bray, an architect and entrepreneur incubated at the Climate Innovation Centre South Africa. Although still in the early stages of prototype development, the Brayfoil wind turbine has already been subjected to comprehensive scrutiny and has passed feasibility trials at the Faculty of Engineering at Stellenbosch, and wind tunnel testing at South Africa's Council for Scientific and Industrial Research (CSIR).

WorleyParsons has been working closely with Brayfoil on optimising the design of the moving wing mechanism, as well as the external skin of the wing that requires flexion and morphing abilities. *"WorleyParsons management has been incredibly supportive since the moment I showed them the groundbreaking technology, and has given significant engineering input on the application to wind power at end user. This move away from large utility wind farms to embedded solutions is now clearly going to become a reality in the near future,"* says Bray. Of particular interest he says is the use of the new turbine on city buildings in good wind resource areas, where it is a disruptive technology to solar PV, being cheaper power in far greater quantity than is available from the sun, on the limited roof areas of city buildings.

Robert's son Matthew Bray, Director of Strategy & Operations at Brayfoil Technologies, explains that

conventional wind turbines have a horizontal axis with propeller blades that require a large amount of space and stable, smooth wind in order to generate power.

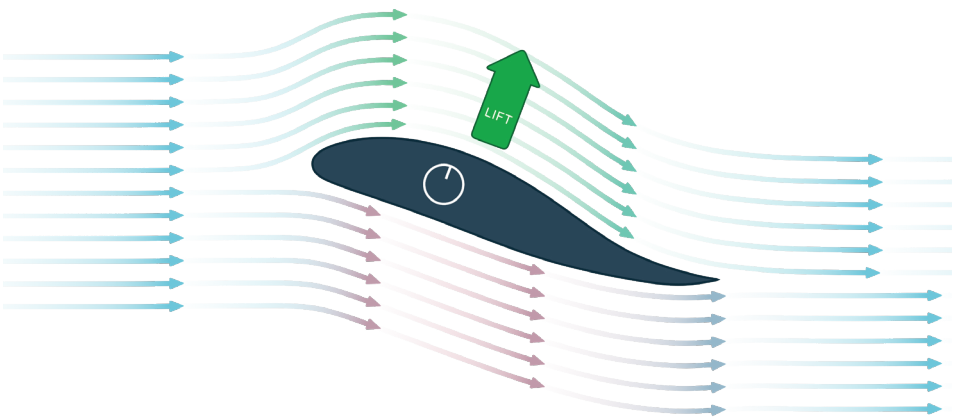
By contrast, Brayfoil wings have reflex sections which allow them to set their own angle of attack to the wind by using a flexing shell that can change shape and create variable lift. *"The benefit of this is significantly higher energy yields compared to conventional turbines, as well as none of the noise or animal mortality associated with large, high-speed turbines and existing small wind turbines in urban areas,"* says Bray. *"What is really interesting is that the turbine blades (or wings) are being made from transparent materials that renders them far less visible than current turbines."*



The wing undergoing testing inside the wind tunnel at the CSIR

Compared to solar PV, the Brayfoil turbine can generate two to 15 times more kWh per square metre of surface area. Being a vertical axis unit, the Brayfoil turbine is not necessarily mounted on a tall tower and is designed to collect energy by the better use of laminar wind flow acceleration and turbulent wind apparent on the edges of buildings or at the cusps of hills, ridges or forest belts, thereby further improving energy yields.

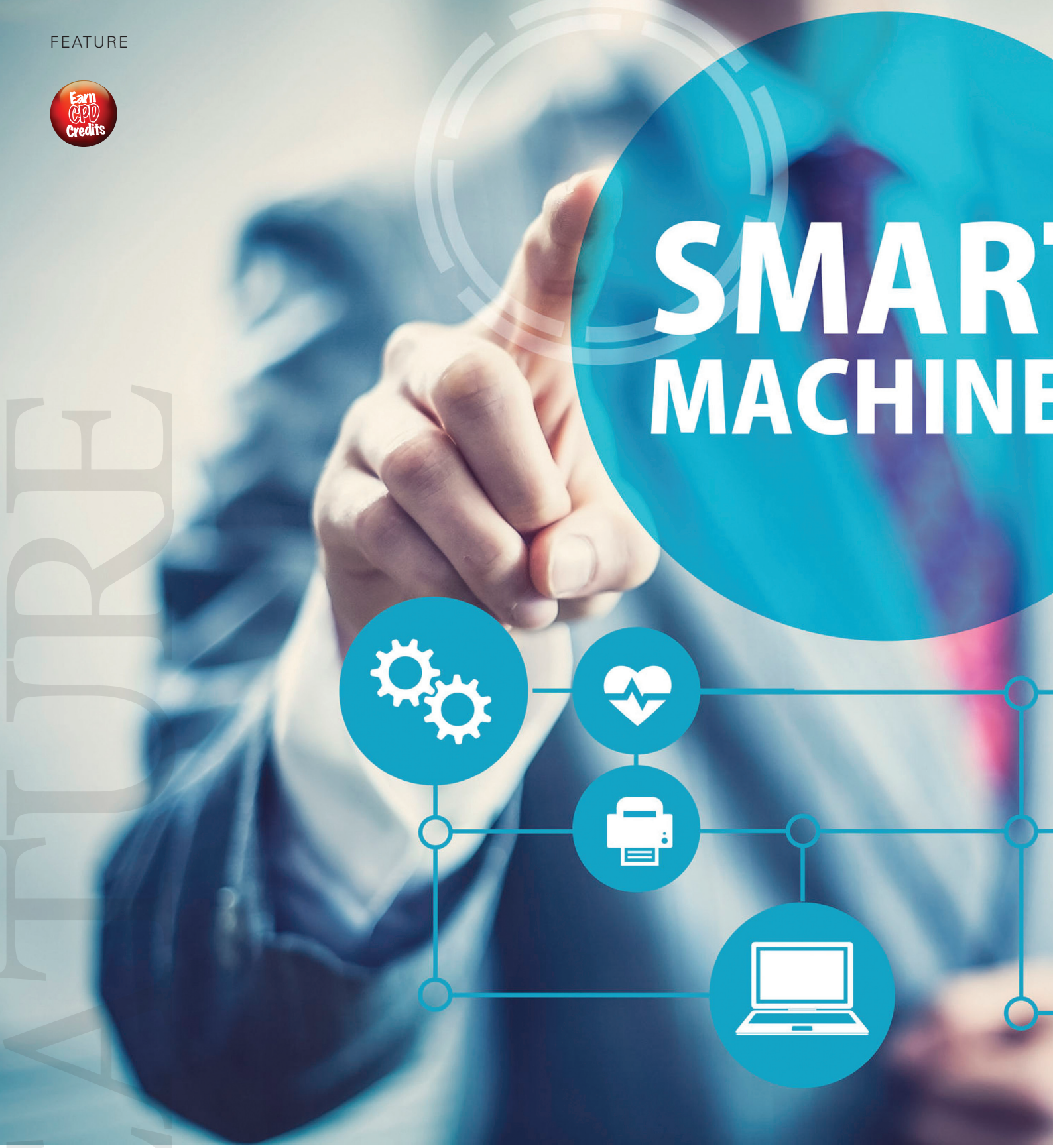
Consequently, the Brayfoil turbine has the potential to make renewable wind energy easily accessible to end-users, as it can operate in urban areas with wind speeds that are significantly lower than current benchmarks for conventional wind turbines. They are also suitable for use in the shipping industry as they can be placed on the decks of ships to supplement energy and reduce air pollution. With new legislation forcing ship owners to comply with emissions levels, the Brayfoil turbine is well placed to solve this problem on a global scale. wn



The morphing wings in a flexed position generating lift

Earn CPD Credits

SMART MACHINE



Two trends that are creating a lot of buzz today are about to unleash a profound change throughout global industry: Industry 4.0, the German based approach for smart manufacturing, and the Industrial Internet of Things (IIoT) with a focus on connected devices and analytics. These trends and the underlying technologies that support them are impacting a broad range of industrial sectors – everything from building automation, transportation, medical, military, security and retail. In this whitepaper, however, the focus is on how industrial automation and machinery will be impacted.

Powered by smart machines, the new industrial revolution is changing how machine builders design and manufacturers operate today and in the future. To remain competitive and profitable, plants and machines will have to be smarter - better connected, more efficient, more flexible and safe. This paper explains the impact of smart machines on the industrial automation and controls business and provides guidance for adapting to a changing industrial landscape.

HOW WILL IT SHAPE THE FUTURE?

BY I DR. RAINER BEUDERT
LEIF JUERGENSEN
JOCHEN WEILAND

There are some obvious similarities and differences between IIoT and Smart Manufacturing (Industry 4.0), as well as areas of convergence. Smart Manufacturing or Industry 4.0 initiatives are focused on manufacturing flexibility, increasing automation levels, and digitization. This is not so much the next industrial revolution but an evolution. In the long run this will reshape complete factories and the way they operate. Such evolution requires embracing a multitude of technologies and ideas which will have a massive impact on end users and OEMs. This will take

Smart Machines

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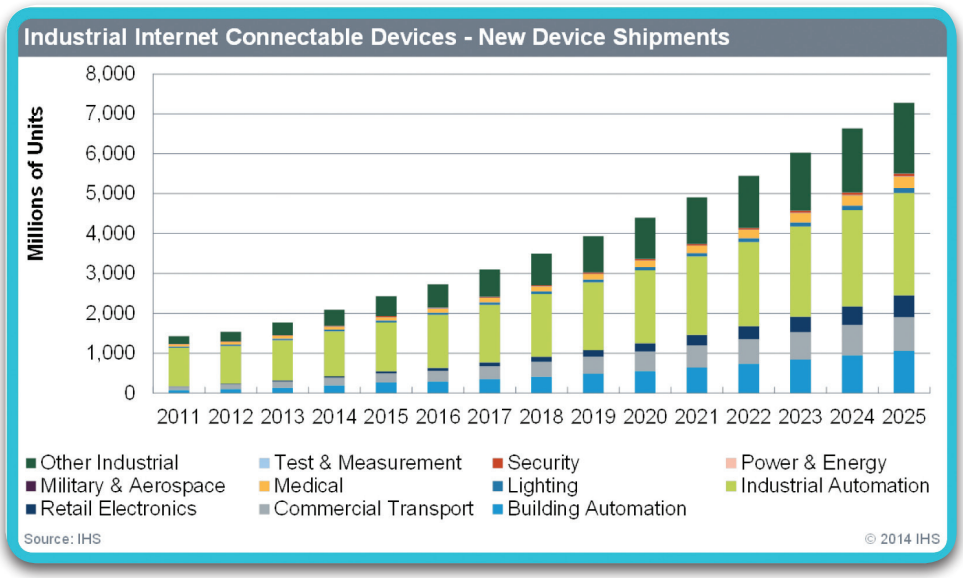

Figure 1 - Illustrates the projected growth of connected devices within the industrial automation domain (along with other sectors).

some time and IIoT, with all its connected devices, will act as a key enabler.

IMPLICATIONS OF IIOT

The IIoT vision of the world is one where smart connected assets (the things) with varying levels of intelligent functionality, ranging from simple sensing and actuating, to control, optimisation and full autonomous operation, operate as part of a larger system.

These systems are based on open and standard Internet as well as cloud technologies. These enable secure access to devices and information in order to leverage big data and analytics and mobility technologies to drive greater business value.

OEMs and end users can leverage IIoT to better monitor and control machinery. Within industrial environments, some devices today are connected, but many are not. IIoT applications will include not only machine-to-machine (M2M) communication but also machine-to-people, people-to-machine, machine-to-objects, and people-to-objects communication. These connections enable the ability to collect data from a broad range of devices and applications. This "big data" can then be accessed via the cloud and analyzed using sophisticated analytics tools.

Some of the elements that encompass this new world of IIoT have actually been around for quite some time. Communications, for example, are not new to the industry. Fieldbus communication, for instance, has been around for decades. This is why IIoT should be viewed as more of an evolution rather than a revolution.

However, new elements like the cloud, cyber security, big data, and pervasive sensing are only just now reaching levels of maturity that enable widespread adoption. The challenge is how to implement all of these disparate yet connected elements into an industrial environment.

IIoT initiatives are also converging with some of the new Smart Manufacturing momentum that is influencing stakeholders. The basis for both of these market trends is to enhance networked resources so that distributed intelligence can lead to improved visibility and management of production.

In order to benefit from the potential that now exists for the development of new levels of operational intelligence, industries will need to migrate, over time, to a plant infrastructure that enables the exploitation of these new capabilities. This is where the next generation of machines – the "Smart Machines" - enters into the picture.

SMART MACHINES

Manufacturing floor machines will evolve their level of intelligence in order to accommodate more predictive planning and more flexible business needs. The term "smart machine" implies a machine that is better connected, more flexible, more efficient and safe, therefore it can quickly respond to new demands. Based upon a collection of smart, connected products, it maximizes efficiency through intuitive collaboration with its users. A smart machine is also capable of participating in predictive maintenance practices while minimizing its own environmental footprint and total cost of ownership.

Smart machine development is influenced by three principal drivers: technology, consumer market trends, and end-user demands.

TECHNOLOGY

On the technology side, both innovation and lower costs are making new generations of equipment accessible to industrial sites

SMART MACHINES

in need of migration. Below is a list of some highlights:

- Ethernet connectivity – Enables integration of networks and improved data access; provides the basis for service-based models and management of security;
- Wireless (e.g., RFID) – Allows for rapid, automatic data entry;
- Mobile technologies – Allows for safer, more remote operation of equipment;
- Increasing CPU power – More throughput is now enabled at lower cost
- Multiple Ethernet ports on automation devices – Enable enhanced connectivity;
- Memory cost decreases - Allows for advanced data management and better decision support;
- Digitization - Allows for low cost development of machine automation simulation programs;
- Reduction of component footprint and heat dissipation – Allows for higher power densities per square foot;
- Ability to connect a wider range of actuators and sensors (smart sensors) – Enables the gathering of more accurate data from which to base operational decisions;
- Augmented reality and biometric recognition - Improve both machine-operator interaction and security.

CONSUMER MARKET TRENDS

The release of new technology increases the expectation of machine operators and system users, and also alters training approaches for both new and veteran employees.

- With internet use common place in many people's lives, the expectation of workers to have access to production information in real time continues to increase;

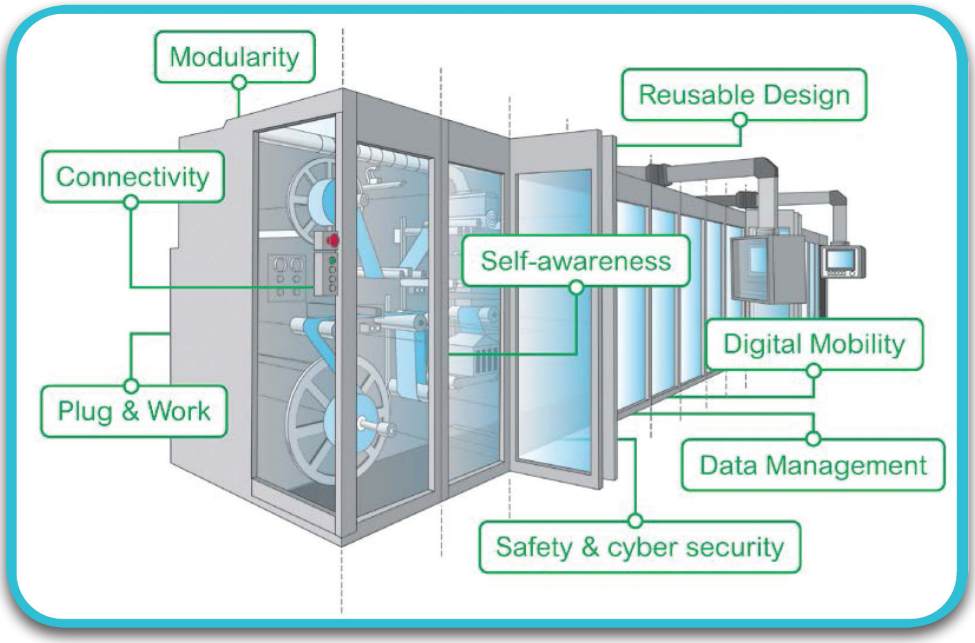

Figure 2 - Aspects of smart machine technologies

- More mobility is increasing the use of mobile and wearable devices to gain access to information at any location;
- Machine operators expect devices (and machinery) to be "plug-and-play" (e.g. as easy to use as an iPhone, television, USB stick, or Bluetooth devices);
- An interactive web mentality is promoting an expectation that smart machines and distributed control centers collaborate much in the same way that people do on social networks.

END-USER DEMANDS

End user demands for ultimate flexibility will drive the manner in which IIoT applications are designed.

In order to accommodate these demands, the following requirements will need to be built into any smart machine design.

- Machines will need to be built to accommodate orders on a mass scale. The ability to manufacture customized products that can be quickly released to the marketplace is also a key consideration. The manufacturing line will need to be flexible enough to allow modification in real time;
- High availability of production and reduction of manufacturing costs;
- Traceability and transparency of products, goods and information;
- Improved asset utilization by intelligent planning;
- Lower total cost of ownership of assets
- Real-time data management including improved supply chain management;
- Easy integration of new technology ensuring compatibility for retrofit and upgrade installations;
- Improvement of product quality and reduction of environmental impact (energy and resources);
- Immediate accessibility to information (50% of maintenance spend today is focused on searching for information);
- Assurance of security and safety in order to protect user and machine.

Smart Machines

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Tight control of production costs and the improvement of overall production line performance will also require machinery that is more functional, flexible, connected and efficient.

Ethernet-based networking of components and resources are key elements of smart machines. Open standards will be a key enabler of adoption, allowing integration of systems, better visibility and an overall improved level of business control. The benefits will be an accelerated product time to market, reduced costs and downtime, better quality, lower energy consumption and increased customization.

CHARACTERISTICS OF SMART MACHINES

The four key characteristics of smart machines include the following:

EFFICIENCY

- **Self-awareness** – With the use of sensors and the intrinsic knowledge regarding its own capabilities and features, a smart machine will be able to monitor its own key components as well as environmental conditions. Embedded intelligence will correlate upstream and downstream behavior and adapt its own parameters within given business rules. By providing relevant information to both operators, connected data consumers at the OEM, and the end user, the smart machine enables manufacturing lines to produce in a more reliable, flexible and efficient manner. Such optimisation can be implemented with respect to energy, time, OEE, load shedding, quality or other parameters via upstream systems that provide set points based on analytics.

This level of machine monitoring also enables preventative maintenance supported by the OEM, helping to avoid component failure and associated downtime or damage to the machine or components. It also allows for maintenance to be scheduled, in order to minimize the impact on production while increasing business opportunities for value added services.

Machines at the forefront of development will increasingly use sensors, both wired and wireless, with embedded intelligence helping to distribute and automate decision making on the factory floor. As the cost of these technologies continues to decrease, more machines will integrate sensors, allowing better real-time visibility.

- **Data Management** – Smart machines must have the appropriate level of intelligence to assess data quickly and in a decentralized fashion. Routing all data to a central control for analysis will quickly lead to delays as it is a non-scalable structure. Sensors, components and machinery with the intelligence to only share data that falls outside of set parameters will lead to better overall data management. Improving the level of data shared with the broader network/community will accelerate decision making and reduce backlogs (where critical information could be delayed or missed altogether).

Storage of data is also an important consideration. To date, hardware has largely been used to store production data, but this method can be very time consuming and expensive to manage. The cloud is increasingly becoming a viable option to help better manage data in a more cost-effective manner.

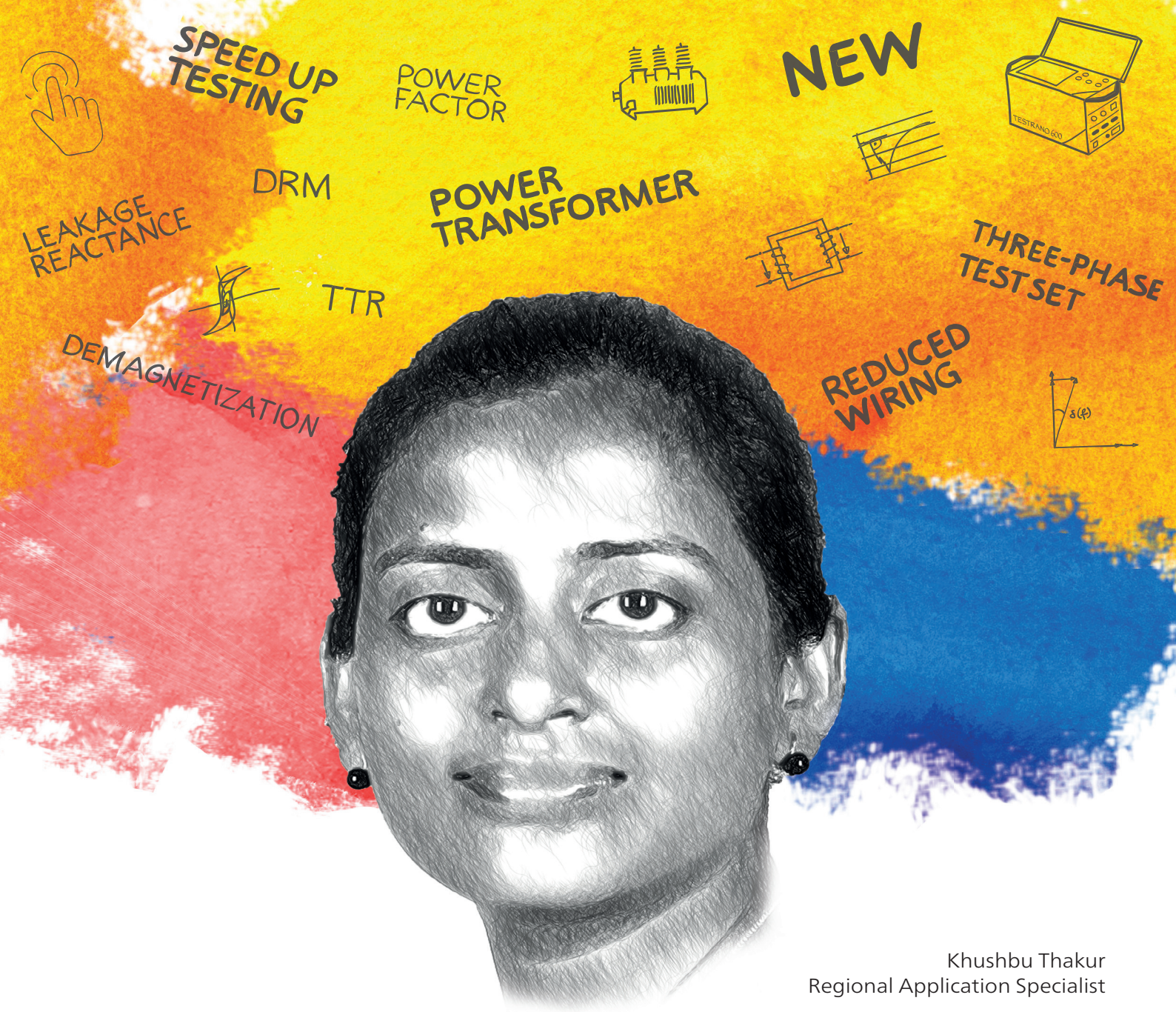
SAFETY & SECURITY

- **Safety & cyber security** – With security built into their fundamental designs, smart machines will improve the safety of operators and minimize the security risk of increased networking. Improvements in machine performance and lifetime cost reductions cannot be offset by reducing the safety or security of the machine or production line.

In terms of safety, machine builders need to offer a broad range of flexible options. This will include dedicated safety components, such as laser scanners and safety cameras, together with automation components with embedded safety, such as safety PLCs and safety drives. The ability to utilize a mix of safety components and controllers, will allow machine builders to fit the solution to specific end user application requirements, helping to improve overall performance and productivity.

Today, data security is the leading inhibitor of end-user adoption of new networking technologies and work processes. The perceived risk of networking components and machinery in order to achieve production benefits is high.

Particularly with IIoT and increasing levels of connectivity, security needs to be considered at numerous levels. Security provision needs to be multi-layered, incorporating hardware, software and services. Machine builders (and automation component vendors) need to assure that end-users are



Khushbu Thakur
Regional Application Specialist

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Smart Machines

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aware of security vulnerabilities, and can manage network infrastructure to minimize the risk of a breach.

To help with education of end-users as to the benefits of smart machines, and how security can be maintained with increased I/P connectivity, use cases and success stories need to be highlighted.

FLEXIBILITY

- **Plug & work** – Any new smart machines will need to be compatible with the existing installations or machinery from multiple OEMs; End-users want devices that can be installed within a short timeframe. Integration into the rest of the system must be easy.
- **Modularity** – The lifecycle of today's machines does not allow monolithic or single purpose design anymore. The fast development driven by time-to-market constraints force OEMs to shift towards Mechatronic Design and modularity. This trend also continues in the software and application part of modern machines. Smart machines will benefit from templates of proven design form simple software functions up to fully functional modules describing mechanics, electrical, motion and interfaces, features and behavior.
- **Reusable design** – Machine builders embrace concepts that are proven, reliable and validated. Modularity is one enabler where the paradigm to reuse software and hardware in a different context requires a new level of thinking. The concept of clear and strict interfaces with well defined behavior that can be tested comes from the IT world and finds its space in automation with some adaptation. This becomes another key smart machine differentiator.

CONNECTIVITY

- **Connectivity** – Smart machines will connect directly to the broader (Ethernet-based) network. This enables data sharing and production planning, which goes far beyond the capabilities of traditional standalone machinery and automation. Smart machines will bridge the information technology (IT) and operations technology (OT) gap, making available production data that can be used in numerous management settings (e.g. stock control, operator scheduling, maintenance, energy management, and product replacement). A basic requirement for this: standards to put values and parameters in a meaningful context and a common language.
- **Digital mobility** – Machine operators and factory-floor engineers are embracing in ever greater numbers the concept of using mobile devices at work (Fig 3). Personnel no longer need to be in close proximity to a machine in order to monitor or manage performance. These devices provide operators with the flexibility to move around while still accessing machinery data. Machine engineers can also diagnose problems and offer guidance remotely, which also speeds up implementation of a solution. This reduces downtime and losses.

COMMUNICATIONS

With smart manufacturing and IIoT a transition is now underway to replace fieldbus protocols with industrial Ethernet variants. The outlook suggests that adoption of industrial Ethernet will future-proof end-user facilities in terms of industrial communication. Continuing reliance on and adoption of fieldbus, without consideration for Ethernet-based alternatives, will likely hurt overall production in the long term.

Today, fieldbus protocols still account for about 66% of new node connections, with industrial Ethernet increasing its share by about 1% per year. The move to Ethernet-based networking is slow currently, but is likely to accelerate as smart manufacturing and IIoT benefits become more substantial and widely recognized.

Industrial Ethernet facilitates the integration of operational and office-based networks, which will form the basis for data sharing

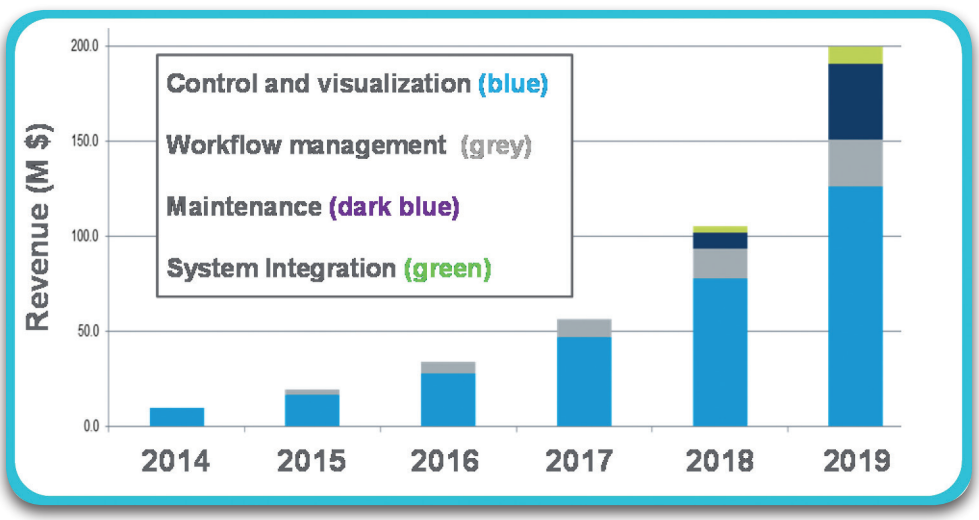

Figure 3 - Global market projections for industrial mobile applications (courtesy of IHS)

SMART MACHINES

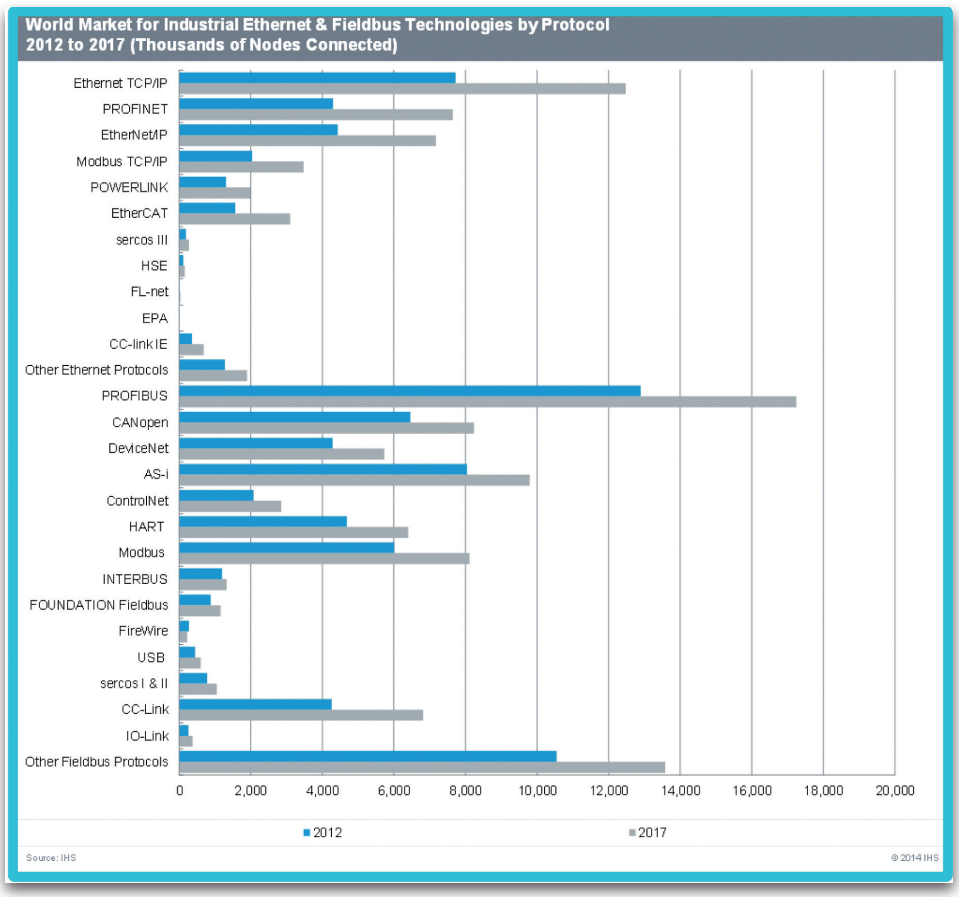

Figure 4 - Networking technology fragmentation

and smarter decision making. However, there will remain a wide variety of variants (see Fig 4), with a mix of application-aligned technologies and those with broader, multipurpose specifications. No single industrial Ethernet standard is expected to emerge in the near future but will certainly develop within the next 10-15 years.

The transition from dedicated fieldbus to industrial Ethernet protocols and the emergence of smart manufacturing initiatives, are reflected in the evolution of Open Platform Communications (OPC) towards OPC UA (Unified Architecture) as a harmonized data transportation and exchange layer. OPC consists of a series of standards and specifications that act as a transport medium between a variety of established industrial communication protocols. It ensures that the correct data is received and transmitted within a set time period, thereby assuring that critical production information is easily accessible. This increased connectivity, however, brings along with it some new security concerns.

End-users need assurance that the risks associated with networking machinery do not outweigh the benefits. Training and education is required before making changes to an existing manufacturing line or when formulating the design of a new line. Here OEMs need to adopt early as this domain requires skills and technologies that are mostly new to their engineering teams. Cyber-Security is also a learning curve for the technology providers. Products that simplify the life of OEM and end user will become differentiators and show a significant opportunity for the automation market.

Continuing development (and networking) of smart machines will need to coincide with management of large data volumes and identification of key pieces of data versus those that are less critical. As these networks grow, the key issue will become what to communicate and not just how to communicate.

STANDARDS AND STANDARDISATION

Perhaps one of the biggest barriers to the adoption of IIoT, smart manufacturing and smart machines is the creation of suitable standards. This is not a simple question of communication protocols. New standards need to encompass creation of standard semantics that will allow smart devices to connect and "talk" to each other without the need for custom programming (as is the case today). These smart devices will also need to "discover" each other and interact.

The development of open standards will provide structure and guidance to OEMs and to end-users, helping them to implement new working processes and to leverage the benefits of IIoT. These standards will need to focus the overall integration of systems and uniformity across the factory floor.

End-users often drive the establishment of local standards. They want to make sure that the hardware and software they have invested in will deliver on their security,

Smart Machines

continues from page 31

safety, and performance expectations. Industrial automation component suppliers, OEMs and associations must collaborate to outline and establish standards that provide end users with the confidence they need with a more global scope.

Associations that work closely with leading automation companies, such as ODVA, MESA, OMAC or PLCOpen which support open standardization with the aim to facilitate interoperability and information sharing in the industrial ecosystem.

Similarly, associations like the Smart Manufacturing Leadership Coalition aim to create standards that will enable end users to merge systems. Rather than maintaining, managing and gathering information from numerous independent systems, the ultimate goal is to work with leading companies to create an open smart manufacturing platform.

INTEGRATION TREND

Convergence of networks and systems will depend on communication protocols that are compatible with one another. If the compatibility is lacking, data will remain isolated and sharing (in real-time) with key stakeholders to aid in strategic decision making will become impossible.

The integration of IT and OT networks and systems is critical to achieving the benefits of smart manufacturing – e.g. reduced downtime, lower energy consumption, operator safety, preventative maintenance and manufacturing flexibility.

Therefore, beyond the factory floor end users (and OEMs) need to consider how smart machines integrate into the wider organization and supply chain, in order to fully reap the benefits of smart manufacturing. Those on the factory floor will be most concerned with uptime, safety and security. Those in the office environment will be most concerned with data analysis and cyber security. Establishing personnel roles for each aspect of the overall system (e.g. data security) is also likely to prove difficult.

Integration is occurring at a number of levels as technology enables devices to be more functional and capable of a wider spectrum of applications. Examples include control products (such as PLCs and drives) that integrate safety functionality and wireless field devices that incorporate processing power. Beyond hardware integration, higher-level system and software integration is now the next step in merging factory floor operations with the enterprise and wider supply chain.

To achieve this level of integration, considerable obstacles need to be overcome, particularly from a safety and security perspective. New fields of activities will emerge for system integrators and consultants on software defined networks (SDN) and software defined automation (SDA) as these technologies are quite new and build a new domain of knowledge and expertise.

SOFTWARE ROLE

The significance of software as an enabler has increased in recent years and this trend will continue. In some cases, software will be replacing hardware in the smart machine environment. It also forms a link between disparate systems, enabling interoperability, and helps to link logical and physical worlds.

Digitization of control system design is an interesting example of the positive impact of software. Simulation/prototyping software is capable of creating a virtual model. This makes it is easier to capture numerous control system requirements, which speeds up the implementation of a design project. This is especially true for the programming phase. In these cases, inaccurate specifications can waste many hours of precious (and costly) time.

Such software simulation tools also allow operators to familiarise themselves with a new system before it is installed. This

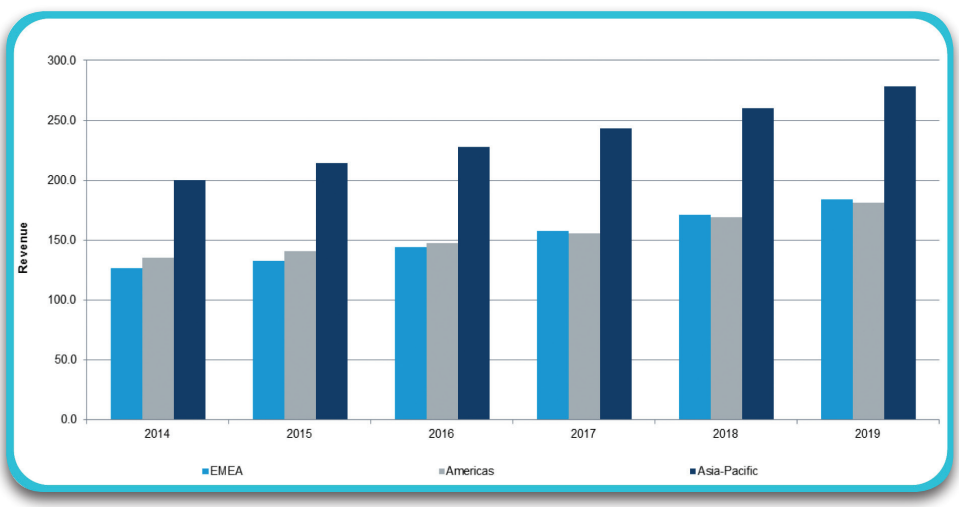

Figure 5 - Digitization of industrial control system design and simulation.

enhances both efficiency and safety. Figure 5 illustrates projected growth of software driven simulation tools across geographies. From a machine builder perspective, the focus is often on practical solutions and simplification of design for mechatronic and control systems. An example of digitization in this capacity is the ability to simulate the automation program without any hardware, which is a substantial advantage.

As CPU power and differentiation on I/O and even sensors become more difficult for OEMs, smart functions will differentiate machines by added values based on software and application. As a consequence, OEMs are encouraged to develop new business models to monetize on new services and features that enable smart integration, data availability, advanced analytics or a wide range of other future options all based on software.

MIGRATION TO THE CLOUD

In the enterprise environment use of the cloud for storing and accessing data is relatively commonplace. The factory environment is more reluctant to adapt this technology. However, IIoT will drive cloud usage in the coming years.

With increasing amounts of production data being gathered and automation devices and machinery being networked, the demand on hardware to store, manage and analyse data will grow exponentially. The cloud storage and platforms now becoming available to end users are secure and reliable, providing a cost-effective method for accessing, storing and integrating data so that it becomes actionable information.

Benefits to end users include reduced hardware costs, utilization of external experts for data management and secure access to production data to aid decision making. For machine builders, this, again, represents a new field of expertise. How to present information from a machine to analytics systems in a machine readable way will be key for integrating shop floor equipment into an IT infrastructure. OEMs that master this will maintain a competitive advantage in the coming years.

In addition to the key challenges of Ethernet-based device networking and the conservative nature of the industrial automation sector, overcoming the concern of security will be pivotal. Educating and training engineers on the benefits of cloud adoption and helping to manage the process of network migration and modernization represent key success factors.

Partnerships are being formed between automation component suppliers and cloud specialists in order to leverage the expertise of both. Large machine builders and end users are sharing industry application knowledge and technology expertise. The idea is to maximize benefits of cloud adoption while minimizing risks.

CONCLUSION

Traditional machines were characterized by high-cost and limited communication technology. New smart machines are using established communication protocols, IIoT devices, and the cloud, to enable life cycle cost reductions, machine performance improvements, and new ways to interact with blue- and white-collar workers.

The new IIoT technologies and practices are evolving over time. Before a large-scale transition to smart machinery occurs, affected workers will require education and executives will require a clear demonstration of payback if they are to invest in improvements. The new technologies will need to prove themselves over time in an industrial environment, and inhibitors such as security concerns will need to be overcome.

Machine builders that want to maintain or improve their market position will make use of control systems that capitalize on the potential of using distributed intelligence in machines. Leveraging new technologies to improve performance and efficiency, while reducing downtime and energy consumption, will allow both machine builders and end users to differentiate themselves from the competition. Those who fail to take any new action will be left behind in a transitioning market place.

In addition, the development of new services to support IIoT and smart machine processes and systems represents a significant opportunity for machine builders, especially in the areas of predictive maintenance and remote access.

Partnerships with specialists in communications, IT, OT and software, will emerge as a critical success factor for end users and machine builders.

Now it's up to standardization groups and the automation suppliers to pave the way for OEMs into the new evolving world.

This will enable a smooth transition into a smart production and manufacturing environment, one that is based on Industry 4.0. wn

The word "drone" is no longer synonymous with "futuristic." Since the Federal Aviation Administration (FAA) passed Part 107 - regulation which opened the door for large-scale, licensed commercial drone work - the use of drones has been growing across the Energy sector. Lower upfront costs of equipment and the efficiencies they provide for existing operations have also catalysed faster adoption.

Drones' ability to provide a real return on investment (ROI) across the energy industry is arguably less than two years old, yet we're already seeing commercial drone use graduate from the fringe cases and internal exploratory studies to enterprise-wide programs being planned and implemented across large and medium-sized companies worldwide.

More than an industry trend, drone programs genuinely offer better data to inform business decisions. They provide a practical solution for everyday problems facing businesses in power Transmission and Distribution (T&D), Wind, and Solar. Furthermore, they support business efforts to avoid hazardous man-hours; reduce costs for maintenance, inspections, and repairs; and improve efficiencies and core competencies across operations.

The Case for Drones in Energy

BY | BRANDON TORRES DECLET | MEASURE

THE VALUE OF DRONE DATA

DRONE DATA IS HIGHLY ACCURATE

To test the accuracy of our drone inspection data, we experimented. We took the results of a solar inspection by drone and sent out manual inspection crews to run the same check on the same plants.

The results the teams came back with from the manual inspection mirrored the results from the drone data with 99 per cent accuracy, but the manual inspection took two days for each site compared to two hours with the drone.

DRONE DATA IS MORE DETAILED

In Wind and T&D applications, drones can capture close-up, detailed imagery of potential defects that enable maintenance personnel to see what's going on really – is the apparent damage at the surface level, or is it structural? Drones can also capture tower, pole, and turbine images from almost any angle, which is often not possible with other inspection methods. In aerial applications, drones spot sub-module defects that manual inspections typically miss. These improvements in data help asset managers make better decisions about needed repairs, thus optimising their maintenance budgets and minimising downtime.

Figure 1.1 Class 1 Damage

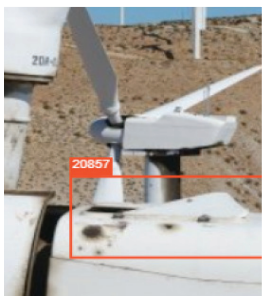

Figure 1.2 Class 4 Damage

Figure 1.3 Class 1 Damage

Fig 1 - various damage spots

Drones in Energy

continues from page 35

DRONE DATA CAN BE MANIPULATED

For example, with a single drone flight, you can get a clear understanding of the shading conditions of a solar site at any time of the year. During construction, you can overlay actual construction progress imagery with site plans to gauge whether construction is proceeding according to specifications.

DRONE DATA IS EASILY CONSUMABLE

For the amount of data that is processed with a typical inspection (e.g. 300 images or 3GB per wind turbine), reading and consuming the information is surprisingly easy. *"The reports are pretty consolidated,"* states Nick McKee, Solar Operations Manager at AES. *"I have a PDF snapshot and a digital snapshot that I can move around and customise depending on what I want to look at."* Data can even be delivered through a smartphone app, allowing field maintenance personnel to proceed directly to the location of identified defects.

DRONE DATA LIVES FOREVER

What many find to be the most valuable part of drone data is that it is documented and lives forever. This allows energy plants to perform year-over-year analysis and gives operations the ability to reference previous inspection data to make smart decisions about future work. Asset managers can even compare the health of equipment across multiple sites.

Documentation is especially relevant where employee turnover is prevalent. In developing industries such as Wind and Solar, the employee who performed the inspection in years prior may not still be with the company by the next time an inspection is required. With drone data, you don't have to reference a person, only a database, to know what the last check picked up.

Fig 2 - Inspection Overview. Visual orthomosaic displaying key site features and issues identified. This image was created via georeferenced imagery collected by drone flyover and later stitched together into a single site overview.

PRACTICAL APPLICATIONS OF THE DRONE

So what is the exact use for drones? Let's look at some sample use cases across sectors.

TRANSMISSION & DISTRIBUTION

Frequency: High (daily - weekly)

Lead-time: Low (hours - days)

For Transmission and Distribution operations, the drone serves a variety of near-term needs when readily accessible. While the applications are endless and new uses for drones are discovered frequently, let's look at a few common scenarios.

SCENARIO 1

TRANSMISSION TOWER SPOT CHECK

Imagine getting a call about a problem with a transmission tower. Without a drone, you order a lineman to go up the tower to inspect the issue, which is dangerous work, to begin with. Adding to the obstacles,

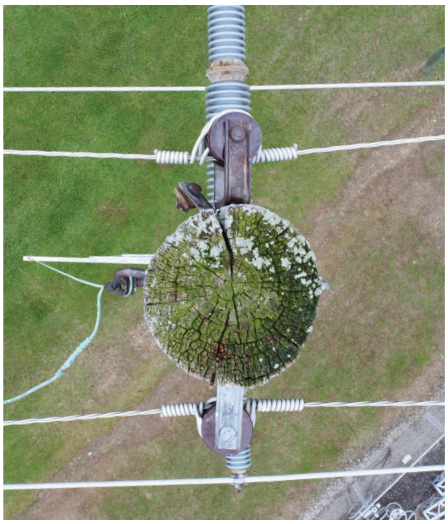

Fig 3 - Inspection Image Examples for Transmission & Distribution

the only way to get to the tower might be through difficult terrain which is only accessible by way of private property, or the tower is above a line of trees, obstructing your view from the ground.

With traditional means, it may take a couple of days to obtain permission to walk across private property then to schedule a small crew to trek to the tower and run an inspection. With a drone and licensed pilot readily available, this can be accomplished in a matter of minutes. Drones can be used in areas too close to trees or homes for helicopters and in the regions that are too difficult to access for ground patrols. There are no hazardous man-hours involved. And you get a clean look at the tower in real time, allowing your team to accurately diagnose the problem and suggest a remedy before you even leave the site.

SCENARIO 2
REGULAR GROUND PATROLS

During routine maintenance, a lineman sees a potential issue with a tower. A utility company that has trained and outfitted their ground patrol teams with drones can direct that lineman to get a better look at the possible defect without climbing or using bucket trucks. When a team member visually identifies a possible fault, they can quickly deploy a drone to get a higher level of detail, better classify the problem, and determine the best course of action, all while avoiding hazardous working hours.

SCENARIO 3
SUBSTATION UPGRADES, MAINTENANCE, & INSPECTION

A problem is reported at a substation. Although easily accessible, substations pose a special challenge because the substation has to be turned off for a human to safely carry out the inspection. In rare situations, this can even lead to a brief power outage for customers. *"Every time we fly, we're saving 2-3 days of work,"* Stephen Dorsett, Contract Coordinator and Journeyman Lineman at Indianapolis Power & Light (IPL) explain.

Without the drone, you'd have to obtain approval before even sending someone up in the truck, a process that could take days.

SCENARIO 4
STORM RESTORATION

A tornado has come through and damaged several towers in its path. Rather than putting men on foot to assess the damage across miles of terrain, you grab the drone and survey the area. With the proper software, the photos are uploaded and stitched together, creating one cohesive map. You're able to see the entire path of destruction and key in on the damaged areas, allowing you to quickly and efficiently plan recovery measures.

These are some well-known scenarios, but the applications of having a drone and UAV (Unmanned Aircraft Vehicle) pilot on site for transmission and distribution are endless. As the only drone operator at IPL, Dorsett gets new requests on a weekly basis. As for uses of the drone, Dorsett says, *"They're a dime a dozen; we're always finding new uses [for the drones]. Across the industry, there are situations where the drone is an extension of yourself."*

Dorsett and his coworker Jessica Franklin, Transmissions Operations Engineer, note that the most value is realised when you combine the abilities of the technology with the years of experience and knowledge of your linemen. *"For a lot of flights, we're looking for one thing and finding something else,"* Franklin explains. *"When you have a knowledgeable operator, you can do a flight, find the problem, find the second problem, and order a resolution all in the same day."*

WIND & SOLAR

Frequency: Low (monthly - annually)
Lead-time: High (weeks - months)

The applications of drones in Wind and Solar typically include various types of inspections conducted at each site no more than annually. Large asset owners may employ an inspection process that rotates through their portfolio of wind or solar farms.

Drones in Energy

continues from page 37

SCENARIO 1
SITE DEVELOPMENT PLANNING & CONSTRUCTION

During site development, drones collect data for topographic modelling, site shading assessment, water body and generator proximity, and soil type analysis to understand how optimised a site is for power generation.

A drone flyover during construction can provide progress reporting, project milestone completion validation, quality control, and logistics planning for easier project management and stakeholder oversight.

SCENARIO 2
COMMISSIONING & ASSET TRANSFERS

Drones offer an efficient and effective method of understanding the quality and operational health of solar and wind farms. In some situations, asset purchasers, financiers, or energy off-takers have a limited amount of time to assess and accept a new solar or wind farm. With intelligent planning and a skilled pilot, drones can capture a sampling of data that will quickly identify any systematic problems and provide stakeholders with the best possible information.

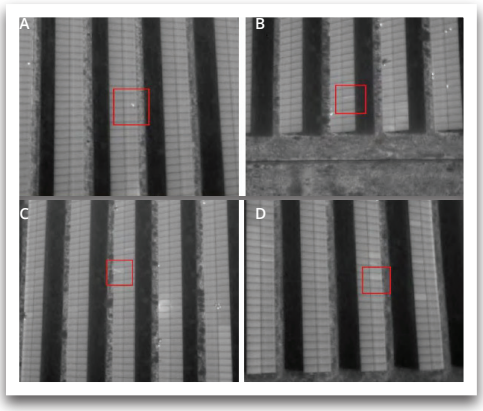

Fig 4 - Thermal Examples of Malfunctioning Module Categories.
A: Single cell or "hot spot" damage.
B: Sub-module string damage.
C: Multiple cells or "hot spots" damaged.
D: Full module damage.

SCENARIO 3
REGULAR AND AD HOC MAINTENANCE INSPECTIONS

For wind and solar plants, an annual inspection is a requirement and one of the most valuable uses of drones. Inspections that could take up to two weeks to perform via traditional methods can be completed in a day or two with a trained pilot and data collection system. The data is, and information about potential defects is delivered to an online portal, allowing tracking over time and across sites. In the case of solar, data provided to a smartphone application enables maintenance personnel to locate damage across potentially hundreds of acres of panels quickly.

These time savings and reductions of hazardous working hours are critical priorities for AES, one of the world's leading power companies that generates and distributes power in 16 countries.

"We are reducing high-risk activities by using new technologies to improve safety, increase efficiencies, and enhance overall company asset management," explains Asel Ayapova, Global Drone Program Manager for AES Corporation.

VALUE PROPOSITIONS BY SECTOR

We've established the who, what, when, and where of drone applications within T&D, Wind, and Solar operations. Now we'll explore why. What is the value of using drones as opposed to existing or alternative solutions?

Drones can provide safe, efficient inspections and data collection for businesses in alternative and traditional energy. Trained UAV pilots and experienced data analysts use drone technology to drastically reduce inspection time, save labour costs and reduce hazardous working hours while providing higher quality data that enables companies to maximise energy production.

There are a few ways that conducted types of inspections are typically completed currently: manually, using climbing, bucket trucks or long-range photography (for wind); or by helicopter. Manual checks involving climbing or using buckets introduce hazards that are avoided with drones. And ground-based data collection typically lacks the efficiency, detail, and flexibility that a drone can provide.

Helicopters can capture data quickly and over large areas of land, but are often expensive, can't operate near residential areas, and can't capture images from the optimal angle or distance.

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Drones in Energy

continues from page 38

SOLAR

For commissioning, warranty, or regular maintenance, drone inspections are 95 per cent more efficient and identify defects, tracker misalignment, shading, tower and substation conditions that manual checks might miss. Drone inspections take less than 10 minutes per MW and save, on average, R15 000/MW in costs, with larger sites saving more. Their higher accuracy can help improve a site's energy production; one customer estimated R600 000 in additional revenue resulting from repairs typically missed by manual inspection.

Inspection data can be sent to a convenient smartphone app, which allows maintenance personnel to efficiently route to damages on site and update inspection results directly from the field. This improves efficiency and reduces costly repair hours.

WIND

Drone inspections identify blade defects faster than manned inspections, avoid hazardous working hours, and improve asset productivity by catching problems before they become failures.

With demonstrated inspection time per turbine of 15-30 minutes, drones reduce man-hours and turbine downtime for maintenance checks by over 75 per cent. Ground-based inspections typically miss 15-20 per cent of damages found by drones, risking higher failure rates and energy losses. Class 5 damage, such as a lightning strike at the blade tip, can lead to 6-8% efficiency loss and 500 per cent increase in failure rate, while class 3 damage, such as a trailing edge split, can result in 3-6 per cent efficiency loss and 200 per cent increase in failure rate.

Drones enhance asset productivity and reduce expensive repairs by detecting and resolving maintenance issues early. With regular drone inspections, you'll also compare assets across your portfolio, track the performance of wind turbines over time, and contrast blade manufacturers and history of damages. With an integrated drone program, you can manage and import inspection data and generate reports that can be filtered for specific needs.

TRANSMISSION & DISTRIBUTION

Drones capture detailed visual imagery, reduce maintenance costs, minimise downtime, and improve safety for electric utilities.

Drones can complete detailed inspections of up to 8-10 kilometers of transmission/ distribution poles per day capturing both thermal and RGB imagery, while substation inspections can be completed within an hour. Drone inspections can deliver a higher level of detail - missing pins, rust, damaged insulators – compared to common ground or helicopter patrols, while also avoiding the hazardous man-hours involved with climbing or using buckets. Utilities may also find that they can save time and cost with drone inspections.

This is especially true after a natural disaster – the terrain conditions may be unknown and using drones can help speed up power restoration.

The cost of equipment, training, software, and support for an internal drone program pays for itself 5 times over with just 80 kilometers of utility lines inspected plus one substation inspection.

Finally, there is the data itself – the more detailed and accurate data delivered by a drone inspection can enable companies to proactively identify more defects, which could lead to fewer power outages and reduced repair costs. An international energy company realised a 95% return on investment for drone inspections in wind farms by way of cost savings and increased efficiencies.

TOUCHÉ - DRONE SHORTCOMINGS

Although drones have become a regular part of the conversation in energy, there are still some shortcomings of the drone that has yet to be overcome that needs to be addressed head-on.

Weather is a common issue that can put a damper on any inspection, drone or otherwise. With drones, high winds over 25 kph can drain drone batteries more quickly, and even higher winds can shut down operations altogether. Excessively cold or hot conditions can also shorten battery life, which means pilots get shorter flight times and need more battery swaps. The quality of data can also be negatively impacted by rain or snow cover.

Location may occasionally be a challenge. Limitations in the ability to fly due to FAA airspace restrictions may affect drone usage in areas close to airports, military bases, or people. The roll-out of the Low Altitude Authorization and Notification Capability (LAANC) system, which gives licensed pilots the ability to request and receive airspace authorisation near participating airports quickly, is making significant reductions to the areas that are off-limits to drones. But, getting airspace authorisation for restricted areas that are not participating in LAANC can still take up to 90 days.

Not everyone can fly a drone, and operating a drone for commercial inspections is not the same as flying recreationally. Operator skill and knowledge are critical to successful, safe data collection. Operating at the wrong altitude, using a flight path without the correct overlap, or having improperly calibrated equipment can all lead to unusable data. Mistakes, like flying too close to power transmission infrastructures, or not following safety and regulatory guidelines, can have disastrous consequences. Here are some additional challenges you might find in specific applications:

TRANSMISSION & DISTRIBUTION

- Due to current regulations limiting drone operations beyond visual line of sight (BVLOS,) large-scale inspections of transmission lines are not cost-effective.
- Drones are also not usually needed for thunderstorm recovery as most damage is visible from the ground.

SOLAR

- Thermal imagery cannot report on the reason for a hot spot on a panel. From time to time, a maintenance person may go out to inspect a defective panel only to find that the hot spot was nothing more than a leaf, bird dropping, or some other element of nature.
- The cost of a drone inspection and data report has to offset the potential loss incurred from the defective panels. For some solar farms, there is a minimum amount of output required by contract; therefore, as long as the farm is meeting that criteria, there may not be a financial incentive to run a full inspection.

WIND

- The quality of the image data is dependent on drone pilot skill and knowledge of the analyst. A trained crewman could get a better feel of what's going on with the turbine through manual inspection. (However, this is an extraordinarily time-consuming and hazardous process that does not offset the costs as a drone inspection does).

  The good news is that drone technology and data intelligence are advancing at a rapid rate. Companies that are setting a foundation of utilising drones now will be quick to adopt and reap the benefits of advancements as they are released.

OK. SO, WHAT?

You've seen data surrounding the impact of drones in Transmission & Distribution, Wind, and Solar operations and you've heard from experts on the ground and in the field about how drones have informed business decisions; provided a practical tool to help fix everyday problems; reduced hazardous man-hours; reduced direct costs associated with maintenance, inspections, and repairs; and improved efficiencies and core competencies across operations.

By now, you might be scouring the web for deals on drones or visiting a website to learn which drone will work best for your needs.

BUT WAIT

There are many nuances and considerations to take into account before dropping thousands of rands on a drone.

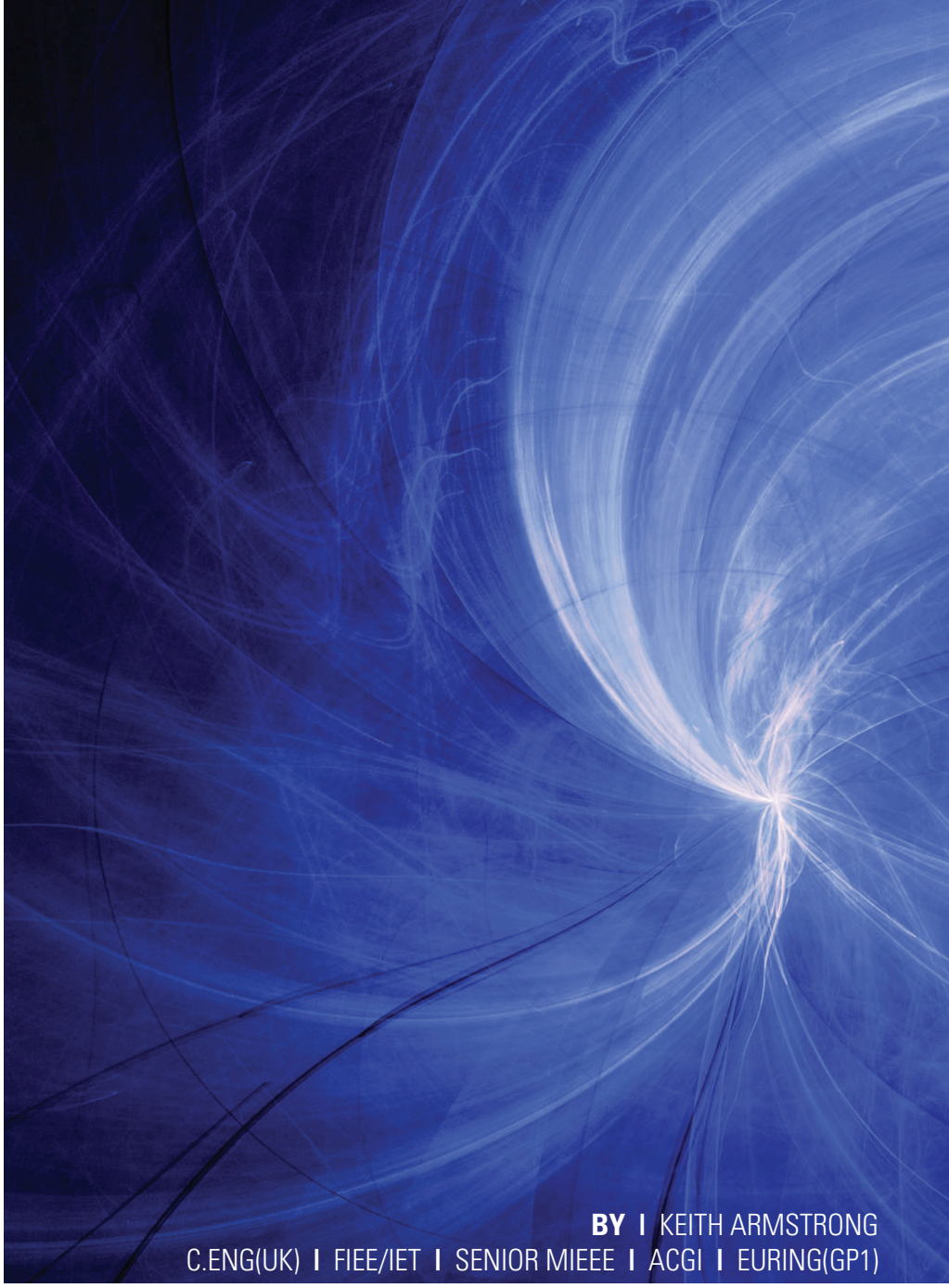
Before you invest in the technology and spend hours reading the instruction material, consider partnering up with a company that has walked this road before, helping multiple national and international energy companies find the best way to put drones to work for their business.

First, figure out whether your specific use case is better suited for a third-party service provider, if and how you should develop your in-house drone program from scratch, or if a hybrid approach of the two is best for you. WN

MEANWHILE... In South Africa ...

The South African Civil Aviation Authority (SACAA) have laid out certain laws and they need to be followed, unless you're one to appreciate a hefty fine or even jail time. If you're intending to fly your drone for commercial gain (that is, if you're that confident in your photography skills that you think you could make a buck off it) you'll require a Remote Pilot License (RPL). Furthermore, you'll need to get your drone, or remotely piloted aircraft (RPA) registered. Although flying a drone solely for recreational purposes does not require registration of the machine, nor the RPL, rules for general use and "no-fly zones" still apply.

There's an awful lot of myth, misunderstanding, and just plain rubbish talked about electromagnetic interference (EMI) and electromagnetic compatibility (EMC). However, the rapid and unrelenting pace of development in electrical and electronic technologies since the 1950s has brought us to the point where achieving EMC (that is, ensuring freedom from significant EMI problems) is needed for the reliable operation of most products, applications, systems and networks.



BY | KEITH ARMSTRONG
C.ENG(UK) | FIEE/IET | SENIOR MIEEE | ACGI | EURING(GP1)

As these developments continue into the foreseeable future, achieving EMC will soon become very important indeed for everything, up to the most extensive networks on the planet. Also, due to the rapid growth in smart/autonomous technologies (e.g. in automobiles, trains, mining, surgery, robotics, etc.), avoiding EMI over the complete lifecycle will soon become essential for human safety.

EMI problems appear to be growing exponentially, especially as developments in semiconductor technologies are encouraging both more powerful processing of signals, data, and control; more powerful power conversion, and more wireless datacoms.

What this means, is that for EMI and EMC, past experiences are not a reliable guide to the future. We have to pay much closer attention to EMI/EMC because the high-tech future we are looking forward to might not happen.

FIRST, A LITTLE BACKGROUND

Electrical power, radio/wireless communications, radiant heat, light, X-rays, etc., are all considered to be

EMI & EMC: the present situation, and what the future holds

electromagnetic, that is, they transfer various forms of power and energy using tightly-coupled electric and magnetic waves. But when we talk about EMI and EMC, we are generally referring to waves having a frequency range from as close to DC (0Hz) as makes no difference, up to 300,000 MHz (300GHz).

When we talk about EMI, we identify the electromagnetic waves that are emitted by all electrical and electronic activities: signals, data, power, etc., from picoamps to Gigawatts. These emissions can be conducted and radiated and should not exceed levels above which other equipment in their operational environment cannot operate as their users need them to. The maximum emissions levels generally depend on the frequencies concerned and are primarily a problem where the 'other equipment' is radio/TV broadcasting or wireless communications because of their high 'in band' sensitivity.

We also identify the propensity of electrical and electronic circuits to suffer noise, errors and malfunctions due to specific frequencies and levels of electromagnetic waves in their operational environments. This is called electromagnetic immunity, or its reciprocal - electromagnetic susceptibility.

EM emissions are also created naturally, by electrostatic discharges such as the shocks we can get in dry weather when touching metal objects, or lightning from thunderstorms. Instead, less natural sources include nuclear explosions that create large pulses of electromagnetic energy which can puncture the insulation of overhead power transmission lines several hundred kilometres away. Engineers specialising in EMI/EMC have a lot of ground to cover!

EMI & EMC

continues from page 43

THE PRESENT SITUATION WITH EMI AND EMC

The typical industry misperception of EMC is that it is a financial burden because it requires expensive testing to specifications; increases production costs; delays time-to-market and adds no value!

But there have long been problems with EMI in real life, and such issues are increasing because the rapid pace of developments in semiconductor devices are lowering their costs and increasing their power so that they are increasingly being used everywhere. Electronics are increasingly replacing older technologies, such as pneumatics, hydraulics, mechanics, electro-mechanical devices, high-voltage transformers, synchronous electrical generators, even people.

Machine learning is finally making electronic artificial intelligence practical, especially in safety-critical applications such as cars and other forms of passenger transport, and the control of national utilities (water, electricity, gas, telecoms, etc.).

This rapid growth in electronics is causing correspondingly rapid increases in EMI problems, but the situation is worsened by the fact that the developments making semiconductors smaller, less costly, and more powerful, are causing them to emit electromagnetic noises to ever-higher frequencies.

The historical misperception of EMI and EMC has been encouraged by the fact that problems have only rarely identified as being caused by EMI, which adds hugely to the cost and delay in solving them. Even when companies discover and fix costly problems due to EMI, they (understandably) rarely publicise this, so everyone else continues to believe EMC is not essential. One result is: many organisations often overlook financial benefits.

There is the real-life example of a UK manufacturer who, in the early 2000s, spent 100,000 GB Pounds on improving the design of his products. He was testing his products to ensure they complied with new versions of the European Union's EMC immunity test standards – while annoying the EMC test engineers by complaining bitterly about 'Brussels bureaucrats' the whole time, claiming they would be the death of his company.

In his first full year of manufacturing the modified products, his warranty claims were 2.7 million GB Pounds lower than had been usual. Why hadn't he identified this considerable cost saving earlier? A 2,700% payback on investment in the first year is a truly excellent result, but EMC is usually overlooked as a financial investment, as happened here.

Realising that this misperception was causing vast amounts of wasted time and money, I started a magazine column on real-life EMI stories in 1998: 'Banana Skins', in the UK's EMC Journal.

People read my column to laugh at other people's mistakes (although some had deadly results and were not funny at all) and painlessly learned about the many real-life problems of EMI and the real engineering and financial need for good EMC. That magazine ceased its existence, but all those EMI stories are still available from EMC standards and are continually being added to: currently at Number 873.

HERE ARE A FEW EMI STORIES FROM THAT ARCHIVE

Any experienced EMI/EMC engineer can tell many similar stories – but usually don't, for confidentiality reasons.

Inadequate EMC specification: A manufacturer of industrial fasteners negotiated a contract with a high-street DIY chain, which required a new production cell containing an automatic weighing machine which filled plastic bags with just the right number of fasteners. A high-frequency plastic welding machine then sealed them. The two devices were purchased separately, and their purchasing contracts had no EMC requirements other than 'shall meet all legal requirements' (CE marking, in other words).

The check-weigher and the bag sealer were supplied, installed and tested successfully when operating one at a time. But when running together, the weighing machine suffered errors of more than 25 % due to EMI from the sealer. There was no comeback on the suppliers because their products met both their legal (CE) and their contract specifications. Both suppliers refused to try to solve the problem, blaming each other. EMI/EMC experts solved the problem, but not before the fastener manufacturer had suffered significant financial losses due to the delay in fulfilling the contract.

Such interference from high-frequency plastic sealers/welders is not uncommon, and is well-known to EMI/EMC experts. This is because the applicable EMC emissions test standard (CISPR11 / EN55011) permits very high levels of emissions at frequencies reserved for 'Industrial, Scientific and Medical' (ISM) purposes, such as this. Radio broadcasting

and communications that must be protected from EMI do not use ISM frequency bands, for that reason.

This is one example of a common situation that has caused and continues to create, massive financial losses. We should never assume that we can construct a system or installation that is free of reliability problems by merely assembling individual items that are each fully compliant with all their relevant EMC standards, even if we follow their manufacturers' EMC installation instructions to the letter (which almost no wiring contractors or installers do anyway).

Trying to avoid this sort of problem by over-specifying EMC can also be financially ruinous. An industrial machinery manufacturer needed a particular inverter drive for a new machine range. His EMC expert specified military EMC standards for these new drives, and the contract to supply them was put out to tender. The drive manufacturer who won the deal didn't appreciate the financial risk issues created by the stringent EMC requirements (which – in my experience – is usual 'Sales Team' behaviour).

They designed the new inverter using their standard methods, it failed its 'MIL-SPEC' EMC tests, and the customer refused to accept it. Time and effort were spent learning new design techniques to comply with the EMC specification, only to find that the redesigned inverters would now not meet their functional specifications!

As a direct result of this failed contract, the inverter-drive manufacturer went out of business. The machinery manufacturer eventually had to revise the drive's EMC specifications and find a new supplier and lost a great deal of money because their new range of machines was very late to market.

HERE'S AN EXAMPLE OF DEFECTIVE DESIGN

A very well-established manufacturer produced high-quality industrial machines that were sold worldwide and renowned for their high reliability. A new management team decided that their poor financial performance was because their products cost too much to make – so began a cost reduction exercise.

The machines had achieved their legendary reliability by using EMI protection measures developed over many years of merely reacting to actual EMI problems in the field. Nobody in the design department had any real understanding of EMI/EMC or any recollection of why these protection measures had been added in the first place, so – when the cost reduction exercise proposed removing the components with no obvious functionality – they were unable to prevent this.

With their historical reputation and new low price, the new machines sold well, but they were unreliable due to weak immunity to their real-life electromagnetic environments. One customer rejected his machine, and a commissioning engineer had to be based in the USA for over a year solely to 'babysit' some others. The excellent worldwide reputation the company had slowly built up over many years was lost in just a few months. A very costly EMI/EMC mistake for them.

NEXT, AN EXAMPLE OF INCORRECT EMC INSTALLATION

A major manufacturer of automotive parts commissioned a series

EMI & EMC

continues from page 45

of robotic paint booths with a total project cost of over 2 million GB Pounds. The EMC specifications for these robots was correct, and the chosen supplier agreed to comply with them and agreed to pay financial penalties for late delivery. By reducing costs to win the contract, the supplier's sales team decided that their customer would have his contractors install the robots' cabling.

The robotic paint booths suffered unconnected (and sometimes dangerous) faults, and the customer would not accept them. Investigations by both the customer's and supplier's staff could not identify the problems. The customer had to employ extra painting staff to meet his production quotas while the supplier was incurring financial penalties for late delivery.

An independent EMI/EMC consultancy quickly identified that the screens of the interconnecting cables had been terminated by long 'daisy chained' wires, ruining their shielding and allowing the control electronics to suffer EMI.

The supplier usually used its trained installation staff to install its products and had no written instructions on the correct termination of the screened cables, so the customer's cabling installers had just terminated their screens any old way. There was no 'quick fix', and 80% of the cables had to be replaced (using correct screen termination methods). The supplier picked up the bill for the re-wiring as well as paying the penalty clauses in the contract.

Even if the robotic paint booth manufacturer had supplied their customer's wiring contractors with complete instructions, other real-life case studies show that this can have substantial financial risks too. When the instructions are ignored by low-bidding contractors, who don't have sufficient assets to produce the product, then it becomes worthwhile suing them through the courts.

WHAT THE FUTURE HOLDS

Wi-Fi was designed to be very low-cost and easy to use anywhere in the world without licensing by using 2.45 GHz and 5.8 GHz bands reserved for ISM frequencies.

But now that Wi-Fi has been so wildly successful, and so many businesses depend on its reliable operation, that fact that it relies upon frequencies that cannot be protected from EMI for example from microwave cookers or neighbouring buildings creates significant financial risks.

All of the semiconductors used to create modern electronics are continually being die-shrunk to make them faster and cheaper, fuelling a rapid rise in increasingly sophisticated electronic control – for which the current media favourite is autonomous cars. We have already seen a dangerous malfunction of an autonomous vehicle caused by EMI (luckily, without an accident). Autonomous mining machines are already operating, independent agriculture is now available, and autonomous road trucks are being advertised.

Within a few years, there are expected to be several million autonomous personal care robots in Japan alone, feeding and washing people who are too ill or old to manage by themselves, before carrying them safely to bed. Quasi-autonomous robotic surgeons are already being used, and new electronic technologies are seen as the only way of being able to continue to deliver affordable healthcare.

Future electrical power distribution systems will be 'Smart Grids' that will operate 'Virtual Power Plants'. Industrial robots now work alongside people without safety screens. And the big debate over autonomous battlefield robots, at the moment, is whether they should be permitted to kill without permission from a human.

All of these near-future developments use much more complicated electronics than we have yet deployed, and they are usually systems of systems (increasingly: systems of systems of systems) about which no single person can understand everything. On top of this increase in complexity, the very die-shrinking that makes this brave new world affordable also makes semiconductors switch faster, which means that – all things being equal – emissions are continually increasing up to ever-higher frequencies.

Developments in power semiconductors, particularly wide-band-gap power switching devices are rapidly increasing the use of variable speed motor drives to reduce energy consumption, to help save both money and the planet.

These are now cost-effective for motors in all domestic appliances, and at the other extreme switching power converters are making it possible to operate high-voltage DC (HVDC) electricity distribution, which doesn't suffer from losses caused by AC coupling with the soil. Unfortunately, every aspect of these developments is creating higher levels of harmonic distortion of AC mains waveforms and increasing the electromagnetic noise emissions from all mains power distribution networks at every voltage level (UHV, EHV, HV, MV and LV) up to ever-higher frequencies.

Air-Gap Wireless Power Transfer (WPT) is a new application that uses switching power converters to generate magnetic fields to supply electrical power without using cables, to everything from cellphones through electric cars to passenger buses and trams, by using magnetic fields.

This is a very rapidly growing area and, at the time of writing, WPT chargers at up to 7kW are already being trialled. It is envisaged that car parks will be fitted with 3kW (or more) WPT chargers in every single parking slot. Because this technology uses an air gap that cannot help but 'leak' magnetic fields – it will increase the likelihood of EMI.

The radio spectrum is already very crowded, and DSA methods are increasingly being adopted to use 'quiet' parts of the spectrum. Powerline telecommunications use a building's mains wiring to carry high-speed data, and the result of both will be higher levels of noise across more of the spectrum, increasing EMI.

The Internet of Things (IoT) and the Industrial Internet of Things (IIoT) are essential modern developments that promise many benefits to many applications, old and new. The US Government is mandating what we might call the Internet of Road Vehicles (IRVs), more appropriately known as V2V Communications.

However, these vast – and hugely distributed – systems, estimated to have a trillion nodes by 2035, will mostly communicate by wireless datacoms. All this additional radio noise will increase the average RF noise levels experienced by all electronics, almost everywhere, causing more EMI.

International commercial and industrial EMC standards are already incapable of coping with the modern world, and the pace of international standardisation has been much too slow to keep pace with technological progress in electronics since before 2000.

So we cannot look for help from that direction, and to cap it all, Intentional EMI (IEMI) is a growing threat to national security and infrastructures from criminals, terrorists and the disaffected.

CONCLUSIONS

EMI is already a significant cause of financial risks and losses in almost all industrial sectors, although because it is invisible and hard to reproduce in real life, it is usually not recognised as such.

These risks and losses are mostly due to decreased operational efficiency and unreliability, but safety is also a concern.

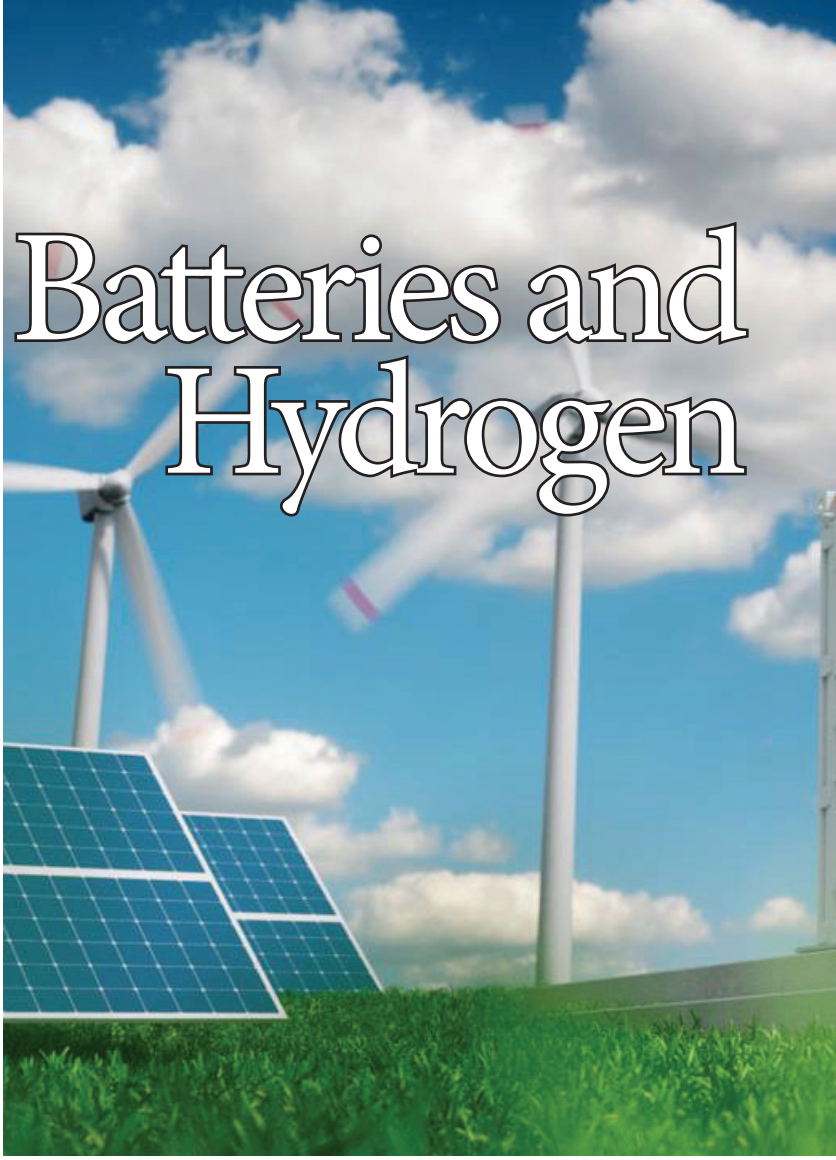
Developments in all areas of electronics and electricity are making the likelihood of EMI ever-greater, in an ever-expanding field of applications.

With the control of all aspects of our lives, including safety, increasingly being entrusted to immensely complex – and often entirely autonomous – electronic systems of systems, the risks of EMI to human safety are increasing very rapidly too.

All of our previous experience of EMI and EMC cannot provide us with a reliable guide to the future, and – if we want to survive – we will not be able to continue to overlook EMC.

Earn CPD Credits

Flow Batteries and Hydrogen



Redox flow batteries show great promise for industrial scale electrical energy storage, which will greatly enhance grid penetration of power from PV and wind turbine renewable energy, absorbing power spikes, as well as levelling power at times of high and low demand.

BY | DUDLEY BASSON

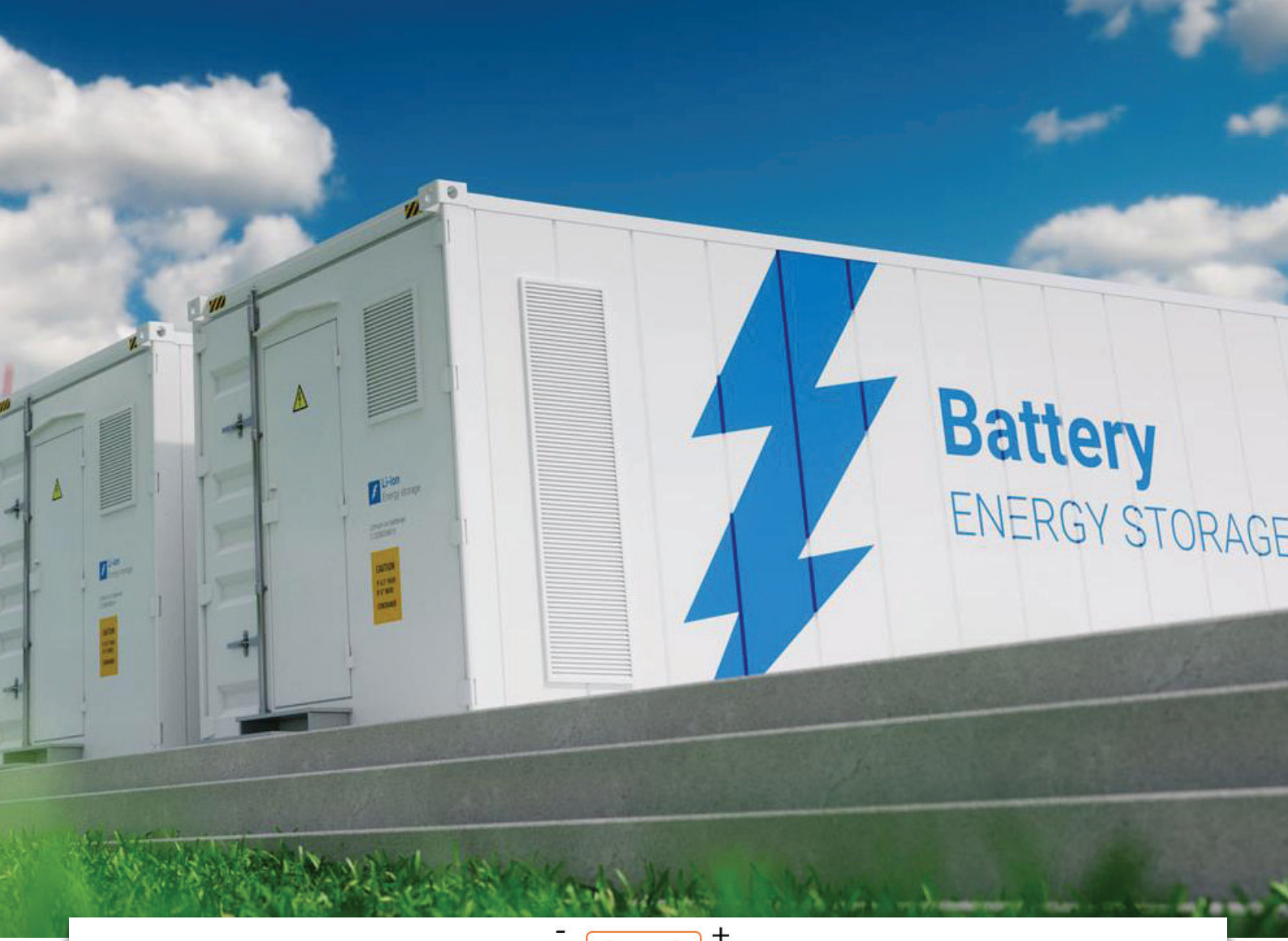
In 1749, Benjamin Franklin coined the term 'Battery' for a group of linked Leyden jars as this reminded him of a battery of cannons. The term battery is now used for either a single or a linked group of voltaic cells. A large variety of batteries is now in common use.

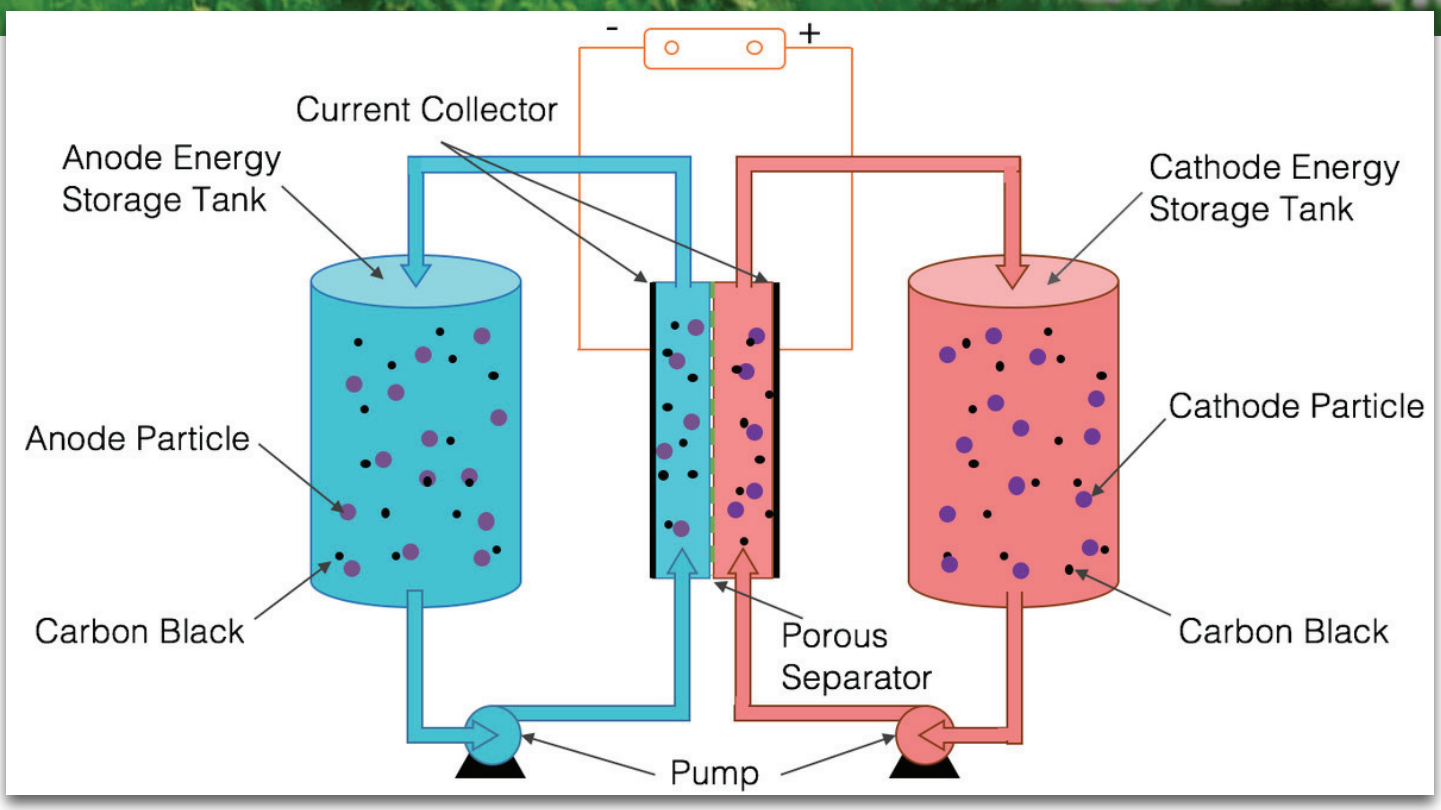
A distinguishing feature of a flow battery is that the input/output power and the energy storage capacity can be separately designed. The power rating depends on the design of the electrode/membrane stack, and the storage capacity depends only on the quantity of electrolyte available.

In the event of the battery approaching a discharged state, it can be immediately recharged by using standby electrolyte tanks. The anolyte and catholyte are in vanadium, and some other flow batteries, the same electrolyte, and if mixed, can be reused by first charging the battery.

Redox (Reduction/Oxidation) is a chemical reaction in which the oxidation states of atoms are changed. This reaction involves an electron transfer in both a reduction process and a complementary oxidation process.

The vanadium redox flow cell concept was developed by Dr Maria Skyllas-Kazacos and co-workers at the University of New South Wales, and patented in 1988. Of the large number of flow batteries that have been developed over the years, it is only the all-vanadium, iron-chromium, zinc-bromine and sodium-polysulphide designs that have come close to commercialisation.





Flow Battery Basics

Flow Batteries

continues from page 49

The vanadium/sulphuric acid battery with single electrolyte is currently enjoying much acceptance.

Energy is stored in the electrolyte as chemical potential energy in vanadium ions in different oxidation states. Vanadium can exist in solution in four different oxidation states. The electrolyte does not degenerate and is not degraded by heavy use or the battery being left in a discharged state. The useful service lifetime of a flow battery stack is usually quoted at 20 years. Even if the battery is decommissioned after 20 years, the electrolyte will remain a reusable and saleable asset. It can be expected that innovative design improvements will be achieved in coming years.

The vanadium redox battery presents little fire risk but the dilute sulphuric acid electrolyte is a highly corrosive and hazardous material requiring strictly enforced safety procedures.

South Africa is in a most favourable position for the establishment of a vanadium/sulphuric acid electrolyte production industry, for local use as well as export, due to the export-favourable exchange rate and the availability of industrial facilities and material.

South Africa has a large, well established, sulphuric acid production industry with an annual production of some three million tons.

A few battery and other energy sources	
Battery or material	**Specific energy Wh/kg**
Vanadium redox flow battery	10 - 20
Lead acid battery	30 - 40
Molten salt (600°C range)	50 - 200
Lithium iron phosphate battery	90 - 110
Lithium-ion battery	100 - 265
TNT	1050
Gunpowder	1300 - 3140
Nitro-glycerine	1770
Hydrogen (fuel cell)	3000 - 9000
Cattle dung	4300
Wood	4490
Coal	7220 - 9140
Lithium oxygen battery	11140
Diesel	12660
Petrol	12880
LPG Propane	13780
Hydrogen (combustion)	33320 - 39430
The nuclear energy of fissile materials is so extreme that the mass of the material is irrelevant.	

This is primarily for use by the mining, fertilizer, battery and chemical industries. Some 100,000 tons of sulphur are imported annually from the Middle East and also obtained from local oil refineries and mines. (Sulphur is a by-product in the petroleum industry. It is regarded as a harmful contaminant in diesel fuel).

South Africa has huge vanadium reserves, and an annual production which peaked at over 27,000 tons in 2003, before the shutdown of Highveld Steel and Vanadium in 2015. Vanadium is currently mainly produced for use as an alloy in the production of high quality tool steel, as well as turbine blades and catalysts.

Flow batteries are not suited to vehicular use due to the large quantity of electrolyte that would be required. It would also be necessary to display "Hazardous Material" signage.

Flow batteries have a low specific energy of 10 - 20 Wh/kg (Watt-hours per kilogram). Lithium-ion batteries have specific energy of 80 to 200 Wh/kg and lead-acid batteries 30 to 40 Wh/kg.

A vanadium redox flow battery of 1 MWh storage capacity would require 50 to 100 tons of electrolyte. Much research is being done to improve the specific energy of flow battery electrolytes. Even a modest improvement would enhance the viability of flow batteries for energy storage on an industrial scale.

The vanadium electrolytes may be prepared by any of several processes, including electrolytically dissolving vanadium pentoxide (V_2O_5) in sulphuric acid (H_2SO_4). The solution remains strongly acidic in use.

The electrodes used are made of carbon and do not take part in any chemical reaction.

The specific energy of explosives may seem surprisingly low compared to less dangerous fuels, but it is the extremely short pulse of ultra-high power that makes all the difference. The efficacy of explosives can be greatly increased by using shaped charges which can focus the power pulse.
The highest pulsed laser power ever achieved was announced by Shanghai physicists in 2016.

This was 5,3 PW, nearly 300 times the global power generation capacity of 18 TW. The pulse duration was less than a picosecond, so that the energy transmitted was only about 5 kJ – not nearly enough to make a cup of coffee.

An alternative and viable method of energy storage would be to use molten salt. This is usually used in conjunction with a CSP (Concentrated Solar Power) farm. CSP has the advantage of utilising all wavelengths of solar radiation. This will however require the availability of Stirling engines or a turbo alternator – either as part of the solar farm or at a conveniently situated thermal power station. To drive a 100 MW turbo alternator for four hours would require a salt tank of about 9 m tall and 24 m diameter. A CSP farm would be able to store or supply solar power as required but cannot store surplus power from the grid unless provision is made for direct heating of the salt by means of grid power. A eutectic mixture of two or three salts (usually nitrates) is used to keep the melting point as low as possible. Ordinary sodium chloride cannot be used due to its high melting point. Only the sensible heat of the salt is used as it must remain continuously liquid.

Incorporating large scale battery storage into an existing power distribution grid is a major undertaking. It usually requires the launching of a pilot plant to test the practicality and software performance of the system in a real life situation.

The ideal form of large scale storage would be the use of a pumped storage hydroelectric power station but this would normally be used on a daily supply/storage cycle and only available at mountainous sites where high and low level dams could be built with a level difference of typically 400 m. A pumped storage power station cannot provide the rapid response required by a fluctuating grid. The Bath County Pumped Storage Power Station in Virginia, USA, is the world's largest with an output of 3 GW. This power station has six Francis sets, each with a pumping capacity of 480 MW and an electrical output of 510 MW. South Africa's 1,3 GW Ingula was fully commissioned in January 2017. A pumped storage power station cannot be regarded as a source of renewable energy as it will normally consume more energy than it delivers. It can only be a source of energy if it is sometimes able to work in run-of-the-river mode.

An initial stage of incorporating grid battery storage would be for levelling the peaks and lows of an established grid. A flow battery has the advantage of very rapid charge and discharge response times.

A second stage would be the grid penetration of renewable power from PV and wind farms.

The third stage (smart grid) would be the most complex, where a large number of end users would both consume and supply power at unpredictable times.

It may be advisable to incorporate the battery in an islanding zone, so that in cases when the grid comes under stress with a risk of loss of synchronisation, or worse still, rolling blackouts, the islanding zones can be isolated to function independently. The disconnecting and later reconnecting of islanding zones raises a number of complex issues and may require the use of a DC inter grid connection.

In China, a pilot plant known as the Hubei Zaoyang Storage Integration Demonstration Project will be launched to test the integration of a 3MW / 12 MWh vanadium redox flow battery. In other countries this would be seen as a major industrial installation. This project will be used to test the grid penetration by large scale PV farms. The next stage will be a 10 MW / 40 MWh project. The ultimate goal is the installation of a gigantic 100 MW / 500 MWh storage system, which will be the largest battery on Earth, and will be the cornerstone of a new smart energy grid. Even at this scale, this is not sufficient storage to level the output of several major PV and wind farms without the contribution from traditional base-load power stations.

German utility EWE Gasspeicher GmbH revealed an ambitious plan to construct an energy storage system that it claims could be the world's biggest battery.

EWE said it would use huge underground salt caverns filled with saltwater to construct a massive redox flow battery system for storing power generated by wind turbines. At Denmark's Aarhus University, the Institute for Engineering

Flow Batteries

continues from page 51

Science has launched their GREENERNET project which will develop a new highly innovative organic redox flow battery, integrated in an optimized microgrid infrastructure, operated by an intelligent Energy Management System. Microgrids represent a large market in Europe. The twofold target for 2016-2018 is:

1. Develop and commercialize a storage system module of 10 kW, 40 kWh based on a breakthrough technology, originally developed by Harvard University and implemented in the 1kW battery prototype, that relies on the electrochemistry of naturally abundant, inexpensive, small organic (carbon-based) molecules called quinones, which are similar to molecules that store energy in plants and animals.
2. Develop an innovative Microgrid Management Platform to optimize the use of the AQDS (anthraquinone di-sulphonate) flow battery, able to monitor microgrid components (loads, energy sources, storage) and to continuously perform a multi-objective optimisation of the energy flows between them and the Power Distribution Grid, whose requests will be taken into account by dynamically adhering to Demand Response programs.

Vanadium battery research at Aarhus University and the University of Porto resulted in the establishment of the Danish/Portuguese spinout company VisBlue. In 2014, Borean Innovation (one of four innovation incubators in Denmark) made an investment in VisBlue and the team behind the company. VisBlue expects to be an international brand on the sustainable energy market. The aim is to be a natural part of major housing developments where energy accounts include solar panels. Solar energy storage is a key quantity in the calculations and can easily determine whether the investment in solar panels will pay off – and whether the development will comply with statutory energy requirements. In June 2018 VisBlue installed a 40 kWh battery on the small Danish island, Livø. The Danish Nature Agency under the Ministry of Environment and Food bought the system this year to support their project "Grøn Livø".

A VisBlue battery solution has been installed in a Copenhagen apartment building which is Denmark's first net-zero energy building which also produces electricity for the residents' use.

A paper presented at the 2017 SAIEE Smart Grid Conference described Eskom's establishment of a battery energy storage testing facility at Rosherville. This paper has been published in the February 2018 issue of **watt**now. This pilot plant will provide vital facilities for testing industrial scale batteries for grid use as well as developing expertise which will eventually lead to smart grid implementation.

South Africa's vanadium scene is being vigorously pursued by UK registered company Bushveld Minerals and its subsidiaries Bushveld Vanadium, Bushveld Energy and Lemur Holdings.

Bushveld Vanadium has a primary focus on the exploration and production of vanadium. The company aims to build one of the world's largest, high-grade, lowest cost and vertically integrated vanadium platforms.

Bushveld Minerals has access to three high-grade deposits located on the Bushveld Complex, which is host to the world's largest primary vanadium resources.

The Bushveld Igneous Complex is the largest layered igneous intrusion within the Earth's crust. It has been tilted and eroded forming the outcrops around what appears to be the edge of a great geological basin. It is approximately 2 billion years old and contains some of the richest ore deposits on Earth, including the world's largest reserves of platinum-group metals which include platinum, palladium, osmium, iridium, rhodium, and ruthenium along with vast quantities iron, tin, chromium, titanium and vanadium.

It was announced in Mining Weekly in November 2017 that Bushveld Energy has deployed its first utility-scale vanadium redox flow battery (VRFB) for testing at Eskom's Rosherville research, testing and development centre. The power utility will test the VRFB, its performance and applications under numerous simulations to validate the operational performance of energy storage systems in local conditions and demonstrate the abilities and maturity of the VRFB for broad commercial use in South Africa and across the African continent.

The testing outcomes will include minimum load shifting, wind and solar generation smoothing, power quality improvement and self-black-start capability.

This follows the completion of market studies commissioned by Bushveld Energy, and the Industrial Development Corporation (IDC), in the second half of 2016, to assess African VRFB demand and opportunities and global vanadium electrolyte demand and requirements.

2019 MEMBERSHIP FEES

EFFECTIVE FROM 1 DECEMBER 2018

Council meeting held on 7 September 2018 approved subscription & entrance fees as from 1 December 2019 will be as per schedule indicated below.

PLEASE NOTE: In terms of Bylaw 3.2 annual subscriptions are due on 1st December 2018.
Council agreed to a discount for fees paid before 31 March 2019. Members are therefore encouraged to pay promptly to minimize increase.

Grade of Membership	**Annual Subscriptions** *Paid before 31 March 2019*		**Annual Subscriptions** *Paid after 31 March 2019*		**New Members** **See Notes 1&4 below*	
	RSA *incl VAT (R)*	Outside RSA *excl VAT (R)*	RSA *Incl VAT (R)*	Outside RSA *excl VAT (R*	RSA *incl VAT (R)*	Outside RSA *excl VAT (R)*
Student	120	105	144	126	144	126
After 6 years study	1 246	865	1 495	1 038	1 495	1 038
Associate	1 246	865	1 495	1 038	1 495	1 038
Member	1 377	956	1 652	1 147	1 652	1 147
after 6 years	1 069	1 117	1 931	1 340	1 931	1 340
after 10 years	1 684	1 168	2 021	1 402	2 021	1 402
Senior Member	1 684	1 168	2 021	1 402	2 021	1 402
after 6 yrs/age 40	1 825	1 266	2 190	1 519	2 190	1 519
Fellow	1 825	1 266	2 190	1 519	2 190	1 519
Retired Member *(By-law B3.7.1)*	774	536	929	643	n/a	n/a
Retired Member *(By-law B3.7.3)*	nil	nil	nil	nil	n/a	n/a

1. The fee for all new applications is R2580.00 which includes an entrance fee of R928.00. On election to the applicable grade of membership the new member's account will be adjusted accordingly and refunds/ additional payment made on request. Entrance fee for Students is free and new Student applicants require payment of R144.00.
2. The Transfer fee to a higher grade is R504.00 for all grades of membership (except Student within 3 months of qualifying).
3. Members are encouraged to transfer to a higher grade when they qualify. It will be noted that the fees of Member and Senior Member grades after 10 and 6 years respectively are equal to the fees at the next higher grade.
4. Members elected after May 2019 pay a reduced subscription fee.

By-law B3.7.1 reads *"Where a member in the age group of 55 to 70 years has retired from substantive employment in the engineering profession, such member may make written application to Council for recognition as a retired person and a reduced membership fee".*

By-law B3.7.3 reads *"any member complying with the conditions of B3.7.1 but who has been a member of the Institute for not less than 25 consecutive years, shall be exempt from the payment of further subscriptions."* Members who comply with the requirements of By-Law B3.7.3 may make written application to Council for exemption from paying subscriptions.

By-law B3.9 reads *"any member in good standing who has been a member for fifty (50) consecutive years shall be exempt from the payment of further subscriptions."*

Members not in good standing by failing to pay their subscriptions by end of June of each year will subject to Council decree be struck-off the SAIEE membership role.

Members in good standing and no longer in substantive employment and do not receive payment or salary for work done may apply to Council for a reduction in their annual subscriptions.

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Flow Batteries

continues from page 52

The testing process will take 18 months, after which the system will be redeployed to a commercial site within South Africa taking into consideration the outcomes of the test results.

An advanced VRFB with peak power of 120 kW and 450 kWh peak energy storage, produced by UniEnergy Technologies (UET), was supplied in July 2018 for commissioning.

Co-developers Bushveld Energy and the IDC, in addition to Eskom, will jointly facilitate access to the battery for independent power producers, energy storage developers and policy decision-makers, as well as various capital providers, for wider familiarisation to realise large-scale adoption of VRFBs.

Siemens Gamesa Renewable Energy (SGRE), currently the world's premier provider of wind power products and solutions has a total installed base of close to 85 GW. Hybrid projects comprising wind-energy, solar PV and other energy sources are becoming a more attractive option. At the company's La Plana R&D site near Zaragoza, Spain, a redox flow energy storage system has been commissioned. The La Plana test-site integrates the next-generation Vanadium redox energy storage system with a wind turbine, solar-PV modules and a diesel generator. The new redox flow battery offers a 120 kW energy output with a storage capacity of 400 kWh. Siemens Gamesa has been refining its knowledge in hybridization over years. A sophisticated flexible hybrid controller is the resulting product of this R&D effort. It is the digital core that coordinates the generation of all energy sources to meet the electrical load, in order to reduce the LCOE (Levellized Cost Of Electricity) of the plant regardless of whether the grid is connected or disconnected. To reduce energy costs the controller is targeting to achieve the maximum integration of renewable energy.

The world's largest lithium-ion battery was installed in South Australia in December 2017.

This monster, situated in a wind turbine farm near Jamestown, has an output of 100 MW and 129 MWh storage.

The South Australian Government notes that for the first time, clean wind energy can be siphoned to the grid 24/7 improving the system's reliability, whether the wind is blowing or not.

On 7 August 2018 automotive manufacturer Toyota announced a $200 billion capitalisation for the production of hydrogen fuel cell powered vehicles. This has huge worldwide implications for several industries, including power distribution and energy storage. Toyota has with a single announcement, changed gear for the entire global energy and power scene. The changeover of road vehicles from hydrocarbon fuel to electric is well underway with production at several thousands of vehicles per week. For several reasons, the choice of power supply between batteries and fuel cells has been in favour of batteries. With Toyota being the largest by far automotive manufacturer on the planet, the choice of fuel cell power will provide huge incentive for other manufacturers to follow suit. The countless filling stations around the globe will need to be able to supply compressed hydrogen in increasing quantity until petrol and diesel are eventually phased out. With battery driven cars used predominantly for city driving, it would probably be more convenient to recharge them overnight at home, as few motorists would be willing to wait for a recharge at a filling station. Hydrogen fuelled cars can be quickly refilled and will have a similar, if not better range per refill than petrol or diesel cars.

A partnership between Audi and Hyundai was announced for the sharing of resources to develop fuel-cell vehicles. Audi board member for Technical Development Peter Mertens called fuel cells *"the most systematic form of electric driving, and emission-free premium mobility of the future."*

Another announcement followed, in which Honda and General Motors, two of the historic leaders in fuel-cell development (alongside Toyota), declaring that they would partner in developing fuel cell vehicles.

With the automotive industry moving predominantly to hydrogen power, this will reduce the huge burden of power supply that would have to have been carried by the electricity distribution grids. The hydrogen production can be done at PV and wind farms without troubling the grid with the vagaries of weather. Much research is being done in producing hydrogen directly from sunlight which will remove the need for electrolysis. The grids will nevertheless still need to be supplied by renewables and will still need huge storage capacity for matching supply to demand.

The large scale change of vehicle power from hydrocarbon fuel to hydrogen may well influence the construction of marine tidal power stations, which may be in places remote from users and grid infrastructure.

Utilising compressed or liquid hydrogen will provide a convenient method of producing, storing and transporting large scale energy. There are several tidal power stations in production, several under construction and several more proposed.

Most notable of the proposed power stations are Mezenskaya Tidal Power Plant, Mezen Bay Russia which will generate 24 GW and 38,9 TWh annually. The Mezen Bay is at the far North West of Russia at the Barents Sea.

The main feature of the Mezenskaya TPP will be a 75 km long barrage across the Gulf of Mezen comprising a 20 km long powerhouse pontoon section, shipping locks, and a 55 km embankment section. The powerhouse section will comprise two hundred reinforced concrete pontoons, each housing ten 3-tiered orthogonal turbine units of 4 MW capacity each. The turbines will operate for 16 hours per day utilising both inflow and outflow of tidal water. The pontoons will be constructed under controlled conditions in dry docks, and then floated into position and ballasted with sand to found them on the sea bed.

Since 1972 the Penzhin Bay (far North East of Russia) has been under investigation for a possible gigantic tidal power station. The tides of the Penzhin Bay are the highest in the Pacific ocean at 9 m, and 12,9 m for spring tides. The tides here are diurnal (one high and one low tide per day), and the tidal water flow volume is a gigantic 360 to 530 km^3.

Two proposals have been developed. The first would use the entire basin and the second, with higher tides, would use the northern part. The southern site would have a capacity of 87,1 GW (190-205 TWh per annum) and the northern 21,4 GW (50 TWh per annum). The site is far removed from any power consumers or distribution grid so the energy could be used exclusively for hydrogen production. Using tidal power on this scale to supply a grid would be a major problem due the power falling to zero for a few hours at each turn of the tide, but no problem at all for hydrogen production. An increased global demand for hydrogen may well create a major incentive for the implementation of this project.

Researchers of the University of Illinois released a proposal on 6 September 2018 of a huge wind and solar installation in the Sahara and neighbouring Sahel that would have an effect on temperature, vegetation and precipitation over a vast area. Modelling studies showed that large-sale wind and solar farms can produce significant climate change at continental scales.

The model revealed that wind farms caused regional warming of near-surface air temperature. The greater night-time warming takes place because wind turbines can enhance the vertical mixing and bring down warmer air from above and which can also slightly increase precipitation.

The wind and solar farms simulated would cover more than 9 million km^2 and generate, on average, about 3 TW and 79 TW of electrical power respectively. This is more than four times the current global power generating capacity. The solar farms would of course supply power for less than half of each day and the wind turbines would also work according to weather patterns. Providing energy storage to buffer this mind-boggling output may seem an impossible quixotic dream, but as with the gigantic Penzhin proposal, hydrogen production might make all the difference.

An interesting tidal power proposal is that of the UK's Severn Barrage. This would be a 16 km barrage across the river Severn where there is a tidal range of 14 m. The barrage would have a total of 214 turbines of 40 MW generating 8,56 GW (17 TWh annually).

This project has been under discussion since 1925. Another proposal was to use, instead of turbines, breast-shot waterwheels similar to the romantic *"Mill on the Floss"* type of waterwheel which would be less danger to sea life.

On 25 August 2017 The European Marine Energy Centre (EMEC) produced their first hydrogen on the Scottish Orkney Islands using surplus marine tidal energy.

Neil Kermode, Managing Director of EMEC, said: *"The Scottish Government is pleased to be supporting this innovative project which will help to partially overcome grid constraints in the Orkney Islands by enabling the storage of excess tidal power generated and using that electricity to produce hydrogen. The project also adds to our growing understanding of the potential role of hydrogen in Scotland's future energy system – something we have committed to exploring in our draft Energy Strategy. The electrolyser was set up to pilot the production of hydrogen fuel from tidal energy – and now we've done just that. This is a tremendous milestone for us and thanks must go to EMEC's staff, the Scottish Government, Highlands and Islands Enterprise, ITM Power and Bryan J Rendall Electrical for helping make this happen".*

Flow Batteries

continues from page 55

The turbine is composed of a floating hull, with two turbines on the lower half of the body which sit just below the sea surface, the prime position for harnessing the energy of tidal flows. The vessel has 16 metre diameter rotors driven at 16 rpm and an output of 2 MW.

The initial driver behind buying an electrolyser was to provide a storage solution to circumvent local grid constraints; the purchase has sparked off other pioneering projects around Orkney looking to use hydrogen for various purposes.

Kermode added: *"One of the most promising uses of hydrogen is as a fuel for transport as it emits no carbon when it is consumed and, providing it's generated by clean renewable energy sources, it becomes a carbon neutral fuel source. Therefore, we could see green hydrogen, over time, replace polluting fuels in our cars, vans and ferries."*

"ITM Power, who specialise in the manufacture of integrated hydrogen energy systems, won a competitive tender to supply a system to EMEC back in 2015. The system's principal component, a 0,5 MW polymer electrolyte membrane (PEM) electrolyser, comes with integrated compression and up to 500 kg of storage".

With the ubiquitous availability of hydrogen, Stirling engines may find wider application in utilising various sources of waste or solar heat, as they could use hydrogen to fill in gaps in intermittent heat supply or varying quality of fuel.

Stirling engines are like omnivorous goats which can be powered by a variety of heat sources. These highly efficient engines can be driven by solar power, any of several combustible gases including hydrogen, hot exhaust gases from IC engines, combustible farm waste or other fuels which may be available. The engines are capable of long service life with low maintenance. They have no valves or fuel or ignition systems and do not have the stringent lubrication requirements of internal combustion engines. Stirling engines usually use hydrogen as the thermodynamic fluid, which remains sealed within the engine. Like goats, these are small animals, usually of less than 50 kW output. Hobbyists are able to construct small Stirling engines from beverage cans and pieces of wire. The Stirling engine was invented in 1816 by Scottish clergyman The Rev. Robert Stirling.

A leading Swedish manufacturer has recently concluded a huge contract, for the supply of containerised Stirling sets, with the South African ferrochrome industry. The three ferrochrome orders would total 72 power units totalling 29 MW output.

On 1 October 2018 the manufacturer announced a letter of intent for the supply of from 44 to 136 containerised power units to South Africa's Glencore Operations. This order would use residual industrial gas to generate from 18 MW to 54 MW with a saving of 154 000 to 476 000 tons of carbon dioxide per year. This project could possibly be the largest waste-to-energy project in Africa.

Coal power is not yet quite dead - Egypt is planning to build a 6 GW coal fired power station. The contract has been won by a Chinese consortium.

A most astonishing claim was posted on 23 August 2018, by chemists of the University of Waterloo, regarding a breakthrough on the road to creating a rechargeable lithium-oxygen battery as an improvement on the lithium-air battery. This was summarised as follows:

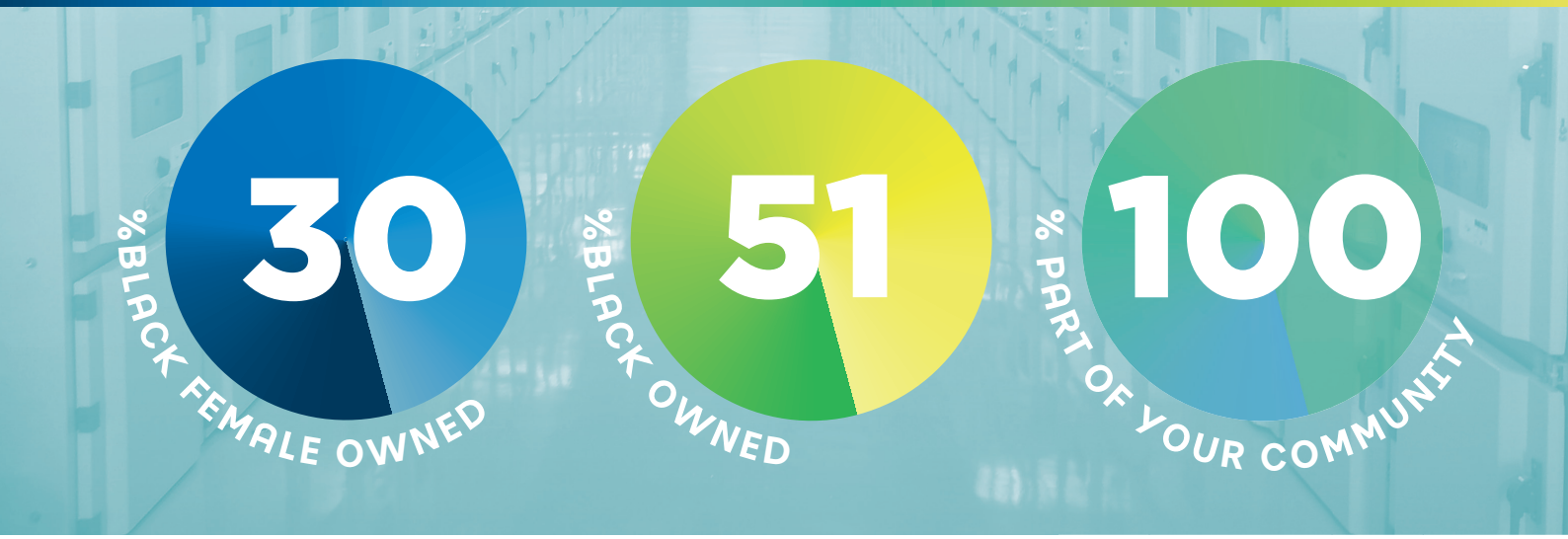
Chemists have successfully resolved two of the most challenging issues surrounding lithium-oxygen batteries, and in the process created a working battery with near 100 per cent coulombic efficiency. The new work demonstrates that four-electron conversion for lithium-oxygen electrochemistry is highly reversible. The team is the first to achieve four-electron conversion, which doubles the electron storage of lithium-oxygen, also known as lithium-air, batteries.

Considerable R&D must still be done to develop the lithium-oxygen battery into a commercial product. One design utilises a molten salt electrolyte working at 150°C, and the maximum number of charge/discharge cycles remains problematic. Lithium-air batteries, redox flow batteries and hydrogen fuel cells all share some similar design features.

The specific energy of the lithium-oxygen battery is given as 11,14 kWh / kg which is close to that of hydrocarbon fuels, and highly advantageous considering the low thermal efficiency of internal combustion engines. The worldwide drive to implement renewable energy generation, and eventually eliminate fossil fuel use, has presented a huge demand for large scale, rapid response electrical energy storage. Huge R&D is being put into battery storage.

Great advances have been made in flow battery research for industrial storage but much more needs to be done. A major breakthrough in battery design will have worldwide implications. wn

Proconics being Brilliant in Africa



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Down Memory Lane

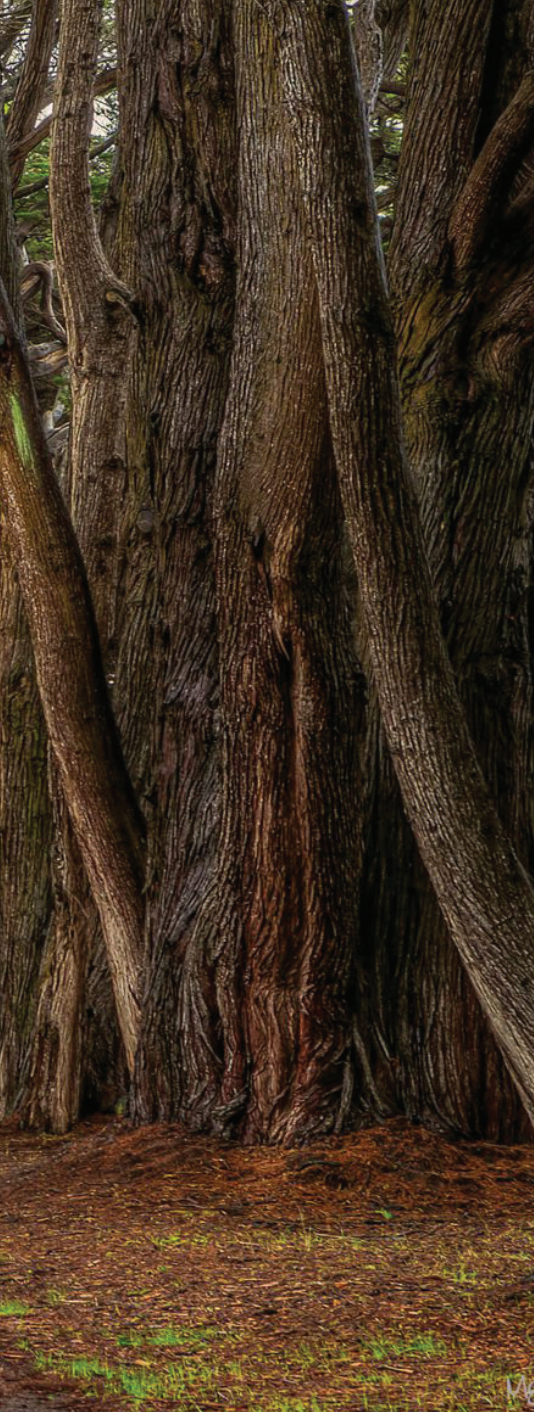
Happy Times at Wits

BY | MIKE CROUCH | FSAIEE | PAST PRESIDENT 1993

THE PYRAMID

One sunny afternoon a group of us were waiting for our mechanical drawing lecturer, Jimmy Drysdale, when we decided to build a human pyramid and reach the steel bar holding the lecture room together about 10 metres up near the ceiling. Some of the front rankers linked arms and formed the first layer, then more lunatics climbed on their backs and so on until our nimblest participant (Dick King) climbed up the pyramid to the very top and was able to grasp onto the steel bar, amid much cheering from the observers far below.

At this critical point someone shouted *"Chips, here comes Jimmy!"* Immediately the pyramid started collapsing leaving Dick King hanging onto the steel bar. We were all soon sitting like angels in our seats when Jimmy walked in and began writing notes on the blackboard for us to copy.



My time as a student at the University of the Witwatersrand was mainly a hard slog to get through all the study assignments and become an Electrical Engineer. There were, however, some happy episodes which I will relate now.

This situation remained for about ten minutes, at which point a shaky voice from the heavens said: *"Hey guys, my hands are slipping!"* Jimmy looked up and saw this person hanging from the steel beam. He went a bright shade of purple, packed his notes and strode out shaking his head. We quickly rebuilt the pyramid and rescued Dick King. The afternoon was then free, and we all went down to the canteen and swimming pool to relax. Life was good!

THE CRICKET MATCH

Our lecturer in Mechanical Design Mr Gimpkey, a German professional who had a very heavy accent, boasted many stock phrases, which he used to emphasise points in the course of his lectures. Some of these phrases were as follows: *"Shentlemen, today we are going to do a rush job and we must make this design very safe"*.

One of our bright sparks decided that the lectures could be enhanced if we organised a cricket match to take place during class. We had two teams, and the scoring depended on words from the lecturer. For instance whenever he said *"Shentlemen"* that would be one run to the batting team. *"Rush job"* earned four runs and *"very safe"* earned a six. Each team was allocated twenty minutes and muffled cheers were to be heard during the match when the score mounted. I don't think Mr Gimpkey realised what was going on.

GOOD ADVICE

At the end of the third year, I obtained a supplementary exam result in mathematics, which meant I had to rewrite the exam again the following January. I did this and still found it very difficult. In those days (1954) failing a subject meant repeating the entire year, so I was most anxious to pass. When the results were due I went into Wits and looked at the notice board...but no results had been put up. So I went to the lecturer's office. He was Mr Clarke, a broad Scott. I knocked on his office door and was invited to take a seat. *"You'll be wanting your results will you?"* In his accent, he asked me to wait a moment while he went through a pile of exam scripts.

Having found mine, he took his red pencil and went through all the pages making annotations all the while. Then, at last, he closed the file and leaned across the desk staring at me and asked: *"Which church do you attend?"* I replied *"Presbyterian Sir"*, to which he responded: *"Well young man, I would advise you to go directly to your church and give thanks!"* I guess I made it by a mark for neatness! 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.

Send your burning questions to minx@saiee.org.za - subject 'WATT?'.

QUESTION ONE

The Internet of Things (IoT) has changed how industries operate today. Will this ever start to affect electric motor installations?

ANSWER ONE

Electric motors, which are used across all industries, are undeniably the largest form of transferring electrical energy into mechanical energy.

This makes these installations critical in terms of controlling operational and maintenance expenditure. However, until very recently little had been done to track the operation of these important machines.

The biggest challenge experienced by end-users who do not have access to reliable operational information is understanding what causes unscheduled downtime or premature failure of electric motor installations.

The great news for electric motor end-users is that this situation is set to change rapidly as companies have started leveraging the latest technology to produce performance monitoring solutions for electric motors and other componentry. These use sophisticated software and operate across the IoT using Apps and web-based platforms and will ensure that operations are ready for industry 4.0.

Many of the devices which can now be used to monitor electric motor performance are being fitted to electric motors during the manufacturing phase. It is also possible to retrofit these performance monitoring devices to existing electric motors.

QUESTION TWO

Why is it so important to gain a better understanding of electric motor operation, and how will this benefit the end-user?

ANSWER TWO

As mentioned above, the operation of electric motors has never really been monitored before and this lack of information poses several challenges. Without any understanding of the electric motor's operation it is not possible to accurately determine out-of-parameter measurements and the end-user therefore has no way to foresee premature failure.

There are several tried and tested methodologies used to protect the electric motor and devices to detect abnormalities during operation. However, none of these offer the ability to monitor the electric motor in real time or provide any form of reliable historical data. Real time monitoring is a critical advantage to end-users as this will facilitate early detection of potential electric motor issues which could if left unattended will result in premature motor failure.

WATT?

Information provided by Zest WEG Group

By having access to accurate historical data, it is possible to build up a database of all installed electric motors in a facility and using this information preventative maintenance and servicing requirements can be optimised, reducing unnecessary costs and more importantly unscheduled downtime.

QUESTION THREE

What sort of operating parameters can be monitored, and why are these important?

ANSWER THREE

One of the most important parameters to monitor on an electric motor is the operating hours. Operating hours are an essential indicator of the time frame between bearing lubrication intervals, and until now this maintenance activity has been conducted largely on guesswork. With access to accurate data, it is possible to schedule this at the correct intervals thereby not only optimising maintenance programmes and reducing costs but preventing premature failure.

Electric motors are engineered to operate within a specific temperature class. Increases in surface temperature of an electric motor is a good predictor that the unit is operating outside of its normal parameters of operation. The temperature increase could be the result for example of high current absorbed due to overload conditions or a sign of premature bearing failure. By having access to this information, it is possible to stage an intervention and take corrective action. This will significantly reduce the risk of premature electric motor failure.

Previously, it has not be possible to continuously monitor motor vibration and this activity, if done at all, is done manually during periodic inspections during operation. Typically, high vibration results from premature bearing failure or alignment which caused by over-tensioning of fan belts, for instance.

With this type of sophisticated monitoring system, the electric motor is monitored continuously during operation and changes in the vibration are therefore readily picked up. The reporting system will alert the end-user to changes in the pre-set operating parameters on the system and allow further investigation to take place to determine the causes. This then facilitates early intervention again reducing unscheduled downtime and unnecessary failures.

QUESTION FOUR

Can this type of monitoring system be expanded to an entire operation, and how will the data be accessible?

ANSWER FOUR

The beauty of the major advances made in software and with the IoT this sort of monitoring system is cloud-based and can be accessed in real time using either an App or a web-based portal. Essentially, this means the end-user will be able to view information and conduct discrete analysis on smart phone or tablets and in-depth analysis will be possible on the web-based portal. Because the information is cloud-based this allows access to more than one person enabling a full team to view the data and engage concerning the appropriate solution.

The monitoring systems available can be extended across major installations that have numerous electric motors in various applications. The system allows for installations to be named in accordance with the nomenclature of an individual facility making it easy to understand. wn

October

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

1 OCTOBER

1969 The French Concorde prototype 001 broke the sound barrier for its first time.

2 OCTOBER

1608 Johannes Lippershey, a spectacle lens grinder, demonstrated the first optical (refracting) telescope to the Netherlands States General. An apprentice discovered that - by separating both a long-focus lens and a short-focus lens in front of the eye - distant objects appeared closer. Lippershey took this one step further by mounting the lenses in tubes, then applied for a patent in 1608. When Galileo heard of the device, he made a similar arrangement and used it to study the heavens.

3 OCTOBER

1980 Rocker Bruce Springsteen, launched his U.S. tour in Ann Arbor, Michigan, and forgot the words to the opening song, "Born to Run."

4 OCTOBER

2000 After more than 40 years of production and over 5 million minis sold, the last mini was driven off the production line at the Longbridge plant in Birmingham, England. The new Mini was given a complete redesign by BMW and went on sale in 2001.

5 OCTOBER

2011 India launched the Aakash tablet computer for just $35 (±R495), which was produced to provide greater internet access to poor students in rural communities.

6 OCTOBER

2010 Instagram, a mainstream photo-sharing application, was founded by Kevin Systrom and Mike Krieger.

7 OCTOBER

2008 Asteroid 2008 TC3 impacted with Earth's atmosphere over Sudan. This was the first time an asteroid impact was detected prior to its entry into earth's atmosphere.

8 OCTOBER

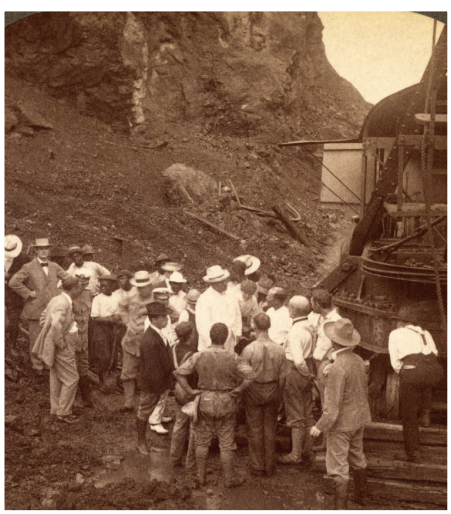
1906 Karl Ludwig Nessler demonstrated the first "permanent wave" for hair, in his beauty salon in Oxford Street, London, England, to an audience of hair stylists. Hair was soaked with an alkaline solution and rolled on metal rods which were then heated strongly. However, this method had several disadvantages including taking a long time (about 5 hours) and expensive for each application.

9 OCTOBER

2006 Google announced their purchase of YouTube for US $1.65 billion in stock after YouTube was officially launched 11 months earlier as it was one of the fastest growing web sites on the Internet with over 100 million video clips viewed daily.

10 OCTOBER

1913 The Panama Canal officially joined the Atlantic and the Pacific Ocean when the Gamboa Dike was demolished with charges of dynamite.



11 OCTOBER

1995 Two Americans, Mario Molina and Sherwood Rowland, and Dutch scientist Paul Crutzen won the Nobel Prize in chemistry for their work warning that CFCs are eating away Earth's ozone layer.

12 OCTOBER

1847 German inventor and industrialist Werner von Siemens founded Siemens & Halske, which later becomes Siemens AG.

13 OCTOBER

1983 The very first commercial cellphone call was made. Bob Barnett, President of Ameritech Mobile Communications, called Alexander Graham Bell's nephew from Chicago's Soldier Field using a Motorola DynaTAC handset, referred to as the "Brick" because of its hefty size.

14 OCTOBER

1968 The first live telecast from a manned U.S. spacecraft, using a black and white camera, was transmitted from Apollo 7 back to Earth.

15 OCTOBER

2007 Singapore Airlines took delivery of the first Airbus Superjumbo, currently the largest passenger airliner in the world.

16 OCTOBER

1987 Paul Holc became the youngest person in the world known to have an organ transplant of any kind when he received a new heart at just three hours old. The heart transplant was performed by surgeons at Loma Linda University Medical Center.

17 OCTOBER

1855 British Inventor and Metallurgist, Sir Henry Bessemer patented steel-making. His patent was for a method of making steel by blasting compressed air through molten iron to remove impurities and excess carbon. The "Bessemer Process," made it possible to mass-produce steel inexpensively.

18 OCTOBER

2004 The US Energy Department reported that the average price for a gallon of petrol in the United States was $2.04 (R6.04/litre). This figure was just three cents under the all-time recorded high for petrol in the U.S., making it the third highest average price ever (at that stage). Now it is about R2.47/litre.

19 OCTOBER

1973 US Federal Judge passed judgement, after a long court trial, which declared the ENIAC patent invalid and belatedly credited physicist John Atanasoff with developing the first electronic digital computer, the Atanasoff-Berry Computer (ABC).

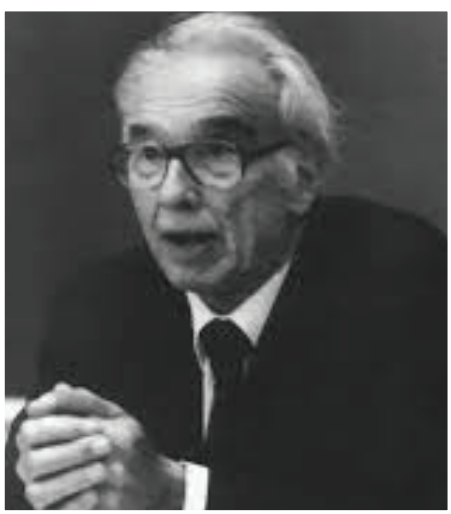
ENIAC (Electronic Numerical Integrator And Computer) was the world's first general-purpose computer. ENIAC was designed and built for the United States Army to calculate artillery firing tables.

20 OCTOBER

1927 A new electrical machine, with a mechanical mind, has been perfected at Massachusetts Institute of Technology (MIT) by Professor Vannevar Bush. The Product, a differential analyser, allows the mathematician/engineer to feed the unsolved equation. The machine can take from 8 minutes to several hours to provide the answer which man alone still cannot solve today.

21 OCTOBER

2002 An attempt to cripple the internet by attacking its central address books in a distributed denial-of-service attack (DDos) caused some problems and temporarily disabled seven of the net's 13 root servers. Due to the design of the Internet, most users were not badly affected.



October

continues from page 63

22 OCTOBER

1938 Chester F. Carlson, an American physicist, inventor, and patent attorney demonstrated xerography. Xerox is a term coming from "xerography" which means dry writing and is now a trademark.

23 OCTOBER

1977 Wesley Paul ran the 42 km New York City Marathon in 3 hours 31 minutes. That was 48 minutes behind the winner, but 15 minutes faster than any other 8-year-old had ever run the race.

24 OCTOBER

1851 William Lassell discovered Ariel and Umbriel, satellites of Uranus. Like most of the other Uranian moons Ariel is named after a Shakespearean character (Ariel is the captive spirit in The Tempest.

25 OCTOBER

1960 The Accutron 214, the world's first electronic wristwatch by Bulova, went on sale in New York City, United States.

26 OCTOBER

1988 Two whales were freed by Soviet and American icebreakers. The whales had been trapped for nearly 3 weeks in an Arctic ice pack.

27 OCTOBER

1999 Dataquest, a company that monitored PC sales, announced that Dell had maintained a 5% lead over Apple for 2 consecutive quarters, which made Dell the #1 in computer sales for 1999. At the same time though, a report mentioned that Apple could now buy Dell if it so inclined.

28 OCTOBER

2018 Today is Mother-in-Law Day (the 4th Sunday in October).

29 OCTOBER

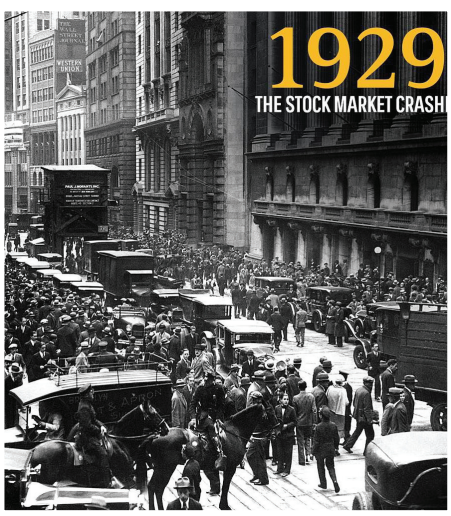
1929 Black Tuesday hits Wall Street as investors trade 16,410,030 shares on the New York Stock Exchange in a single day. In the aftermath, America and the rest of the world spiraled downward into the Great Depression.

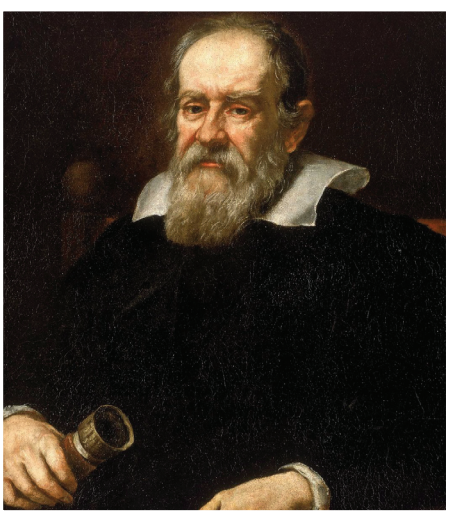
30 OCTOBER

2006 Oprah Winfrey gave $1000 Bank of America debit cards to each of her 310 audience members on a broadcast of her syndicated talk show.

31 OCTOBER

1992 The Vatican admitted erring for over 359 years in formally condemning Galileo Galilei for entertaining scientific truths such as the Earth revolves around the sun it. The Roman Catholic Church long denounced them as anti-scriptural heresy. After 13 years of inquiry, the Pope's commission of historic, scientific and theological scholars brought the Pope a "not guilty" finding for Galileo. Pope John Paul II himself met with the Pontifical Academy of Sciences to help correct the record. In 1633, at age 69, Galileo, 17th century Italian mathematician, astronomer and physicist was forced by the Roman Inquisition to repent and spent the last eight years of his life under house arrest. wn





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calendar

OCTOBER | NOVEMBER 2018

OCTOBER 2018

9	Substation Design and Construction	Cape Town	khuvutli@saiee.org.za
10 - 11	Photovoltaic Solar Systems	Johannesburg	roberto@saiee.org.za
17 - 19	Operating Regulations for High Voltage Systems for Authorised Persons	Johannesburg	roberto@saiee.org.za
17 - 19	2018 IEEE International Conference on Automation	Chile	ieee-ica-acca2018.ubiobio.cl
21 - 24	2018 IEEE International Workshop on Signal Processing Systems (SiPS)	Cape Town	sites.ieee.org/sips2018/
22	Advanced Microsoft Excel: Practical Data Applications for Engineers	Kwa-Zulu Natal	saiee@iafrica.com
24 - 25	Writing Electrical Specifications	Johannesburg	roberto@saiee.org.za
23 - 24	SA Energy Storage & Smartgrid Conference	Johannesburg	www.energystorage.co.za
25 - 26	High Voltage Testing and Measurement	Johannesburg	roberto@saiee.org.za
26	Annual SAIEE Banquet	Midrand Conference Centre	geyerg@saiee.org.za
26 - 28	2018 Conference on Information and Communication Technology (CICT)	India	www.cict2018.in
31 - 1	Earthing and Lightning Protection	Johannesburg	roberto@saiee.org.za

NOVEMBER 2018

6 - 7	SANS 10142-1. 2017 Edition 2 & OHS Act	Eastern Cape	roberto@saiee.org.za
8 - 9	Earthing and Lightning Protection	Eastern Cape	roberto@saiee.org.za
27	IITPSA Banquet	Johannesburg	www.iitpsa.org.za

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