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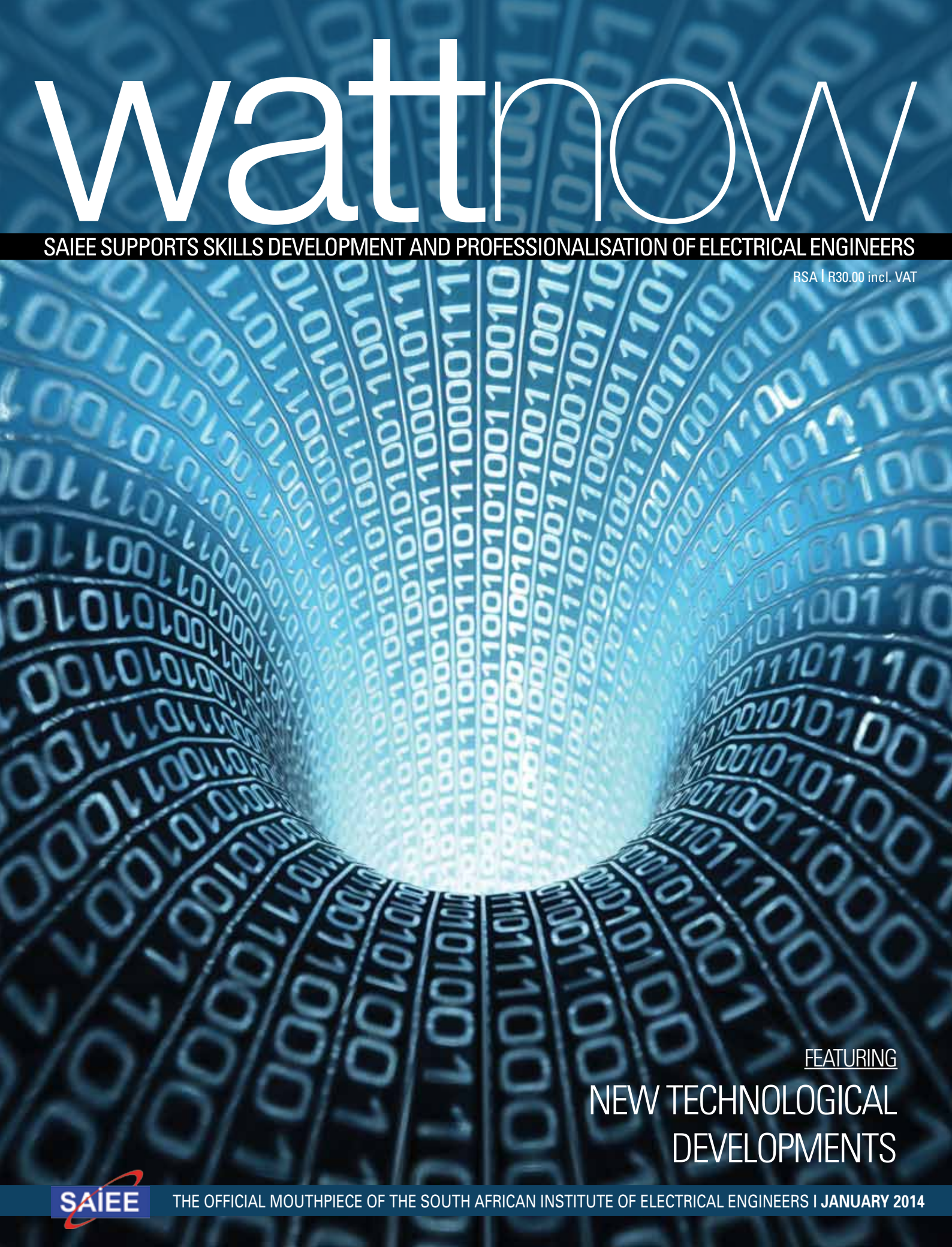

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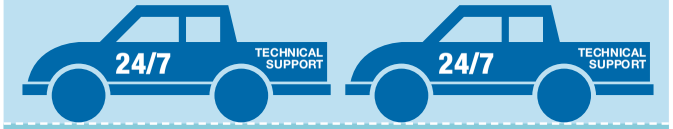

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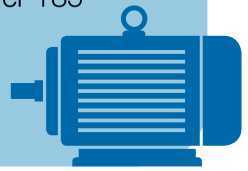

1961	1980	1991	1994	1997	1998	2002	2002	2007	2007	2007	2008	2009	2010	2010	2013	2020
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wattnow magazine

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It is with sadness that I write this letter.

During a time of fluffing out tail feathers for the new year and a giddy sense of what lies ahead during 2014, we said goodbye to a man who was an icon in his own right.

An esteemed member of the SAIEE, Mr Alan Meyer, sadly passed away at the end of November 2013. He was a fountain of knowledge, and will be sadly missed. Mr Meyer's wife, Ethne, their 3 children and extended family are in our thoughts during this time. He leaves a huge void at the Institute's Head Office and Council. Please read the eulogy for Mr Meyer on page 19.

This issue of **watt**now features "New Technological Developments" covering some very interesting articles, from the 10 best technological innovations in the world (page 30) through to Gino Bougaardt's article on the benefits of Cloud Computing (page 42).

The SAIEE recently held their National Student Project Competition at the University of Pretoria. It was absolutely fascinating to learn what the students from each University, and University of Technology, had developed! Each participant walked away a winner for his or her efforts being nominated for this competition. You can find the details on page 10.

Before the new year gets too busy, please go through your dusty bookshelves, or the archived folders on your PC, and see whether you have a paper / or article in storage, which you had always wanted to publish, but never got round to sending it out. Please send it to me – I will be very happy to share your knowledge or experiences with our readers. You will also earn 1 CPD credit if your paper/article is published in the **watt**now magazine.

As the whole world welcomes a new dawn with hope in their soul and happiness in their hearts, I wish you, our readers and all members of the SAIEE, a New Year that sees your dreams coming true, and fills your heart with Happiness!!!

Have a prosperous 2014!

Minx

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Greetings to you all.

As this is the first issue of **watt**now for 2014, I thought that I would summarize the exciting year that I have had as the 2013 President of the SAIEE.

Although my theme for the year started out as "Independent Power Production and Infrastructure Development", it has evolved to concentrating on Infrastructure development, and more particularly, "Skills Development" as required for the National Development Plan. The South African President announced, in his 2012 State of the Nation address, that SA will embark on a massive infrastructure development plan.

"For the year 2012 and beyond, we invite the nation to join government in a massive infrastructure development drive. We are going to launch a huge campaign of building infrastructure nationwide. This will boost the level of economy and create job opportunities" so said President Jacob Zuma in his State of the Nation Address in February 2012 which was reinforced in 2013 by the Minister of Finance.

My major concern has been twofold:

- Will Eskom cope with the increased demand?
- Do we have the required skills set in South Africa to cope with the massive new build programme, and indeed the requirement to develop the renewable energy plant currently under construction?

The first problem is the issue of Eskom coping with demand. This issue was again evident in November with Eskom enforcing a compulsory 10% reduction from the energy intensive users, which has in all fairness, prompted an angry response from the industry. It is ironic that Government intends to spend billions of Rand on a massive infrastructure development programme, that includes a fair amount of energy intensive mineral beneficiation industries, while Eskom cannot cope with the energy demand from the existing energy intensive industry. This industry, which by the way is a major employer, and provides thousands of jobs to many South Africans, and hence is the very lifeblood of many millions of its people. An industry that has been brought to its knees by exorbitant price increases is now requested to cut back production to conserve energy.

The first power from the new coal fired power station at Medupi will only come on stream much later in 2014, and it will probably be another year before the remainder of the units come on line, while the first unit at Kusili will be even later. My biggest concern is that some of the older stations, which are forty to fifty years old, will be pensioned off soon, and then we will back in the same crisis situation.

Fortunately, we now have the Renewable Energy Independent Power Producer Programme (REIPPP), which has proved to be an extraordinary success. The REIPPP has been brought about by the DOE (Department of Energy) with competitive bids for grid-connected renewable energy in South Africa.

The country has introduced 64 new solar, wind and biomass projects which has included more than R100bn of private investment in South Africa, and has seen prices fall dramatically. Bid prices for solar photovoltaic power have fallen 68% and wind energy 42% over the past two years.

By its very nature, renewable energy from solar and wind farms are not despatchable, and will require back up from some sort of base load fossil fuel generation station. Eskom will decide on the percentage of renewable energy that can be tolerated in the generation mix.

It is unfortunate that the Independent System and Market Operator (ISMO) bill has not yet been issued for comment, and it's implementation could be a long time coming.

IRP 2010 has served it's purpose, but it is also dated, and will be reviewed by the National System Operator in 2014 (hopefully) with input from industry players.

To quote Eskom, -*"the power system will remain tight for the next few years until they manage to add substantial new capacity online and they are confident that, by the end of this decade, it will have added a total of 17,1 GW to the grid. This will boost its capacity by almost 50%. In addition to this, independent power producers producing renewable energy will be an integral part of the power system. In the immediate future, however, the company faces the challenge of managing a constrained power system. During the summer months the power system will be tight for most of the day, instead of just peak hours, primarily due to air-conditioning load. In order to ensure that the ageing power stations in Eskom's portfolio are sustainable for the long-term, the utility has planned for more maintenance programmes than in previous years."*

As President of the SAIEE, my primary concern remains the issue of providing and retaining sufficient numbers of skilled engineers, technologists and technicians in this country. Not only to manage the power generation construction works, but also the transmission and distribution network, and to attend to the backlog of maintenance on the rapidly aging municipal infrastructure.

The SAIEE has managed to wade through an enormous amount of bureaucracy and has succeeded in securing a certain amount of SETA funding. This funding is to commence with the mentorship programme, and will hopefully be in a position to match up retired 'greybeard' engineers as mentors in specific disciplines early next year.

We believe that the tertiary education facilities in the country are producing good 'lateral thinking' engineers, however it is up to industry to provide the training and mentorship to mould these young people by sharing hard-gained practical experience.

I wish you all, our members, your families, the SAIEE Head Office Staff and all our advertisers a very prosperous 2014.

Paul van Niekerk | Pr. Eng | FSAIEE
SAIEE President 2013

WATTSHOT

Gear up to a few adrenaline outings to work off the excess weight you've put on over the holidays. A gadget and gizmo for every one... whether it is a gift or just a self-spoil - go ahead, you deserve it!

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All the products featured on pages 8 & 9 are available from www.mantality.co.za unless specified differently.

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WATTSUP

2013 SAIEE NATIONAL STUDENT PROJECT COMPETITION

The participants in the 2013 SAIEE National Student Project Competition are from left to right: Sirus Salem (UJ), Michael Coutlakis (Wits), Gerrit Maritz (SU), Schalk-Willem Krüger (NWU), Ridwaan Amod (UKZN), James Shorten (UP), Ricardo Sampson (CPUT), Sean Melrose (UJ), Daniela Massiceti (UCT), André Hoffmann (SAIEE Senior Vice President), Martin Heydenrych (NMMU), Jacques van der Mescht (VUT), Keagan Malan (Wits) and Louis de Klerk (CUT).

The floating trophies

The 2013 National SAIEE Student Project Competition kicked off on a sweltering day on the campus of the University of Pretoria's Engineering Faculty.

Prof Sunil Maharaj, Head of Department of Electrical, Electronic and Computer Engineering at University of Pretoria opened the proceedings, followed by an address from the SAIEE Senior Vice President, André Hoffmann.

Twelve students, each representing their University or University of Technology from all over South Africa, were flown to OR Tambo to participate in this prestigious event. They were each allocated 12 minutes to make their presentations.

Each participant received a Certificate of Participation, and a cheque from André Hoffmann. Three Discretionary prizes were awarded to students whose projects showcased engineering excellence, innovation and novelty.

The first discretionary prize went to Martin Heydenrych from NMMU (B Tech) (Nelson Mandela Metropolitan University) for his investigation into Gait Generation of Microcontroller-based Quadruped Robots, with three degrees-of-freedom appendages. His presentation included a three-legged robot, which resembles something from the "War of the Worlds". It was really fascinating.

The second recipient of a discretionary prize was Schalk-Willem Krüger (BSc) of NWU (North Western University) for his research into an Intelligent Transport System. He demonstrated how a self-driving vehicle (of the future) will avoid obstacles en-route, and will communicate the info to other vehicles. "This might be technology of the future, but as we all know, what we research now, defines our future," he said.

The third discretionary prize went to the team of the University of the Witwatersrand, Keagan Malan & Michael Coutlakes, for their project titled "The design and

The judges - from left to right: André Hoffmann, George Debbo, Stan Bridgens, Jane Buisson-Street, Sy Govender and Ian Gebbie.

The winners of the 2013 National Student Project Competition. Left to right: André Hoffmann (SAIEE Senior Vice President), James Shorten (UP), Ricardo Sampson (CPUT), Stan Bridgens (SAIEE Business Director) and Prof Sunil Maharaj (HOD Electrical, Electronic and Computer Engineering).

development of a prototype super-capacitor powered campus bicycle".

The first prize in the B Tech category went to Ricardo Sampson from CPUT (Cape Peninsula University of Technology) for his presentation themed "Utilising phasor measurement units to detect Power Swing and Out-of-Step".

The first prize in the BEng category went to James Shorten from the University of Pretoria for his research into "Image guided robotic feeding system for disabled people".

The first prize winners each received a beautiful floating trophy and a cash prize.

Stan Bridgens, Business Director of the SAIEE, addressed the ceremony and thanked all the students for their presentations. Prof Roelf Sandenberg, Dean of EBIT Faculty (Energy, Building & Information Technology), UP had a few words of encouragement to the students on their future endeavours.

The SAIEE would like to thank our sponsors of the National Student Projects Competition. They are: University of Pretoria for hosting the event, Rotek and Roshcon for the prizes. The goody-bags were sponsored by Actom, Aberdare Cables, University of Pretoria, Eskom, Sasol Technology and Zest WEG Group.

Sirus Salem with his Autonomous Mapping Robot. *Martin Heydenrych with this 'tripod' robot.* *Schalk-Willem Krüger with examples of his I.T.S.*

Christiaan Behr and James Shorten. *Daniela and Robi Massiceti.*

Ridwaan Amod *Martin Heydenrych and Crystal Rowe* *Roelof Richter and Sean Melrose.* *Jacques & Suhette van der Mescht*

Lucia and Johnny Pelser *Keagan Malan, James Braid and Michael Coutlakis.* *Prof Roelf Sandenberg, André Hoffmann, Prof Sunil Maharaj and Stan Bridgens.* *Schalk-Willem Krüger and Joubert de Wet.*

WATTSUP

A CAREER IN IT HAS STAYING POWER

As the field of information technology (IT) continues its fast-paced development, the demand for IT professionals such as programmers, system architects and computer network specialist, grows in tandem. Authorities predict that IT will continue to dominate 'careers of the future' as it responds to the needs of the business world, commanding new specialities in emerging segments such as social media, mobility and security.

Professor Elize Ehlers of the University of Johannesburg's (UJ) Academy of Computer Science and Software Engineering, advises that the current demand for skilled IT professionals is high, both in South Africa and globally. *"Forecasts hold that it will take time to remedy this shortage. If the world economy picks up, the necessity for skills will be all the more pressing."*

Students considering a career in IT should enjoy analytical thinking and problem solving. Says Ehlers, *"They must be able to think conceptually, have up-to-date technical knowledge and communicate well, as they will have to deal with a variety of stakeholders"*. Competence in mathematics with an above-average pass in the subject is advised for matriculants.

IT in South Africa can be studied at universities, technical colleges and privately-run tertiary institutions as degree courses, diplomas and certificates. While colleges tend to focus on a specific methodology or language, Ehlers says universities teach concepts so that students are equipped to tackle a range of technologies.

Choosing an institution that has the benefit of industry input is, of course, enormously beneficial to IT students. UJ's Academy of Computer Science and Software Engineering makes the most of a dedicated body of alumni, all leaders in the IT sector, who bring real world lessons learned in the workplace back to the lecture hall. These high-profile business executives are engaged in part-time lecturing, mentoring and research support.

Their involvement recently assisted the Academy in obtaining international accreditation of its BSc Honours Information Technology degree for the third time. The degree course was recognised by London-based BCS, The Chartered Institute for IT, which praised the participation of alumni. The endorsement means that students who successfully complete this degree can now join the BCS as professional members and go on to achieve international status as certified Information Technology Professionals (CITP). The accreditation enhances the employability of the UJ graduate.

CESA APPOINTS NEW PRESIDENT

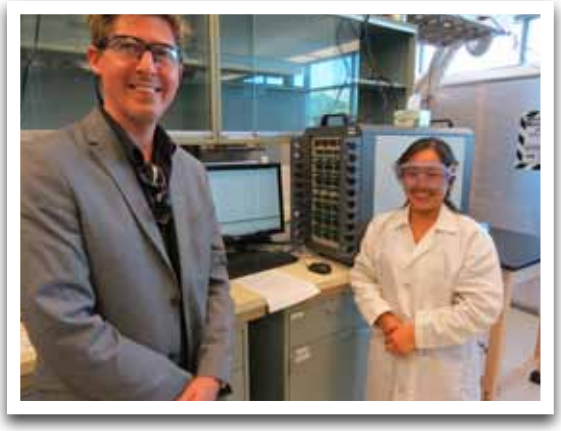
2014 CESA President, Abe Thela

At the Consulting Engineers South Africa (CESA) AGM held at the CESA Conference in Cape Town on Monday 11th November, Abe Thela from Nyeleti Consulting was appointed as President of the organisation for the coming year. *"I look forward to serving CESA as President and thank you for appointing me to this important position within our industry"*, stated Thela at the conference.

Abe Thela is a civil engineer with over 20 years' postgraduate experience, mainly in consulting civil engineering. He completed his schooling in Soweto and matriculated in 1984. In 1982 he was selected to attend a pilot phase of the organisation called Programme for Technological Careers (Protec), which started in Soweto. It was during his participation at Protec that he was exposed to various technological careers including civil engineering.

He enrolled for a degree in civil engineering at the University of Witwatersrand and graduated in 1988. His interest is in municipal services provision and infrastructure development for the betterment of the lives of all South African communities. Abe is a principal and an executive deputy chairman of Nyeleti Consulting. For the past five years he has served on various committees of CESA.

TECHNOLOGY IMPROVES ELECTRIC CAR BATTERIES



David Kisailus and Jianxin Zhu stand between a computer where they do battery testing.

By creating nanoparticles with controlled shape, engineers believe smaller, more powerful and energy efficient batteries can be built

Batteries that power electric cars have problems. They take a long time to charge. The charge doesn't hold long enough to drive long distances. They don't allow drivers to quickly accelerate. They are big and bulky.

Researchers at the University of California, Riverside's Bourns College of Engineering have redesigned the component materials of the battery in an environmentally friendly way to solve some of these problems. By creating nanoparticles with a controlled shape, they believe smaller, more powerful and energy efficient batteries can be built. By modifying the size and shape of battery components, they aim to reduce charge times as well.

"This is a critical, fundamental step in improving the efficiency of these batteries," said David Kisailus, an associate professor of chemical and environmental engineering and lead researcher on the project.

In addition to electric cars, the redesigned batteries could be used for municipal energy storage, including energy generated by the sun and wind.

The initial findings are outlined in a just published paper called *"Solvothermal Synthesis, Development and Performance of LiFePO4 Nanostructures"* in the journal Crystal Growth & Design.

GADGET INSURANCE A SURE THING

SureThing SA, the country's newest most affordable gadget insurance solution has launched. www.surethingsa.co.za covers all your personal electronic gadgets for as little as R70 per month.

SureThing SA provides immediate, inexpensive and reliable insurance for your cell phone, tablet, game console, laptop and MP3 player.

Registration is easy. Simply fill in your details online at www.surethingsa.co.za and your cover will be activated immediately.

SureThing SA was founded by Richard Neville who noticed a gap in the insurance market for portable electronic items. The company set about establishing a cost-effective, quick, online gadget insurance service for the young people of South Africa.

"Historically, portable gadgets were only included on insurance policies if you owned your own home. Surething SA is an easy online insurance solution for everyone who owns a cellphone," said Neville.

"We know how precious and expensive portable electronic devices are and we want to empower young people to take responsibility for these items. SureThing SA is a no-question asked company that aims to provide our customers with secure and effective insurance." For information and to register visit www.surethingsa.co.za.

ENERGY EFFICIENCY TAX INCENTIVES NOW OPEN FOR BUSINESS

National Treasury published section 12L on 8 November 2013 in Government Gazette No. 37019 which puts into operation deductions of energy efficiency savings in terms of the Income Tax Act of 1962. This long-awaited announcement is welcomed by the Certificated Measurement & Verification Professionals (CMVP) industry that has been advising clients to prepare for the imminent release for a while now.

Minister Pravin Gordhan, Minister of Finance, gave notice that section 12L of the Income Tax Act, 1962 (Act No. 58 of 1962), (Deduction in respect of energy efficiency savings), comes into operation on 1 November 2013.

The 12L allows deductions calculated at 45 cents per kilowatt hour or kilowatt hour equivalent of energy efficiency savings. A person claiming the deduction must obtain a certificate issued by an institution, board or body prescribed by the regulations. Such bodies can be found on the South African National Accreditation System (SANAS) website www.sanas.co.za.

To claim for energy efficiency savings from National Treasury the Regulation requires that a baseline must be set at the beginning of an assessment year with a reporting period of the energy use at the end of the year of assessment and that such savings calculations meet the full criteria and methodology used to calculate energy efficiency savings. No double dipping is allowed, which means concurrent benefits in respect of the energy efficiency savings may not be received.

WATTSUP

ALTIUM ANNOUNCES PREMIER EDA SOLUTIONS AS EMEA RESELLER OF THE YEAR

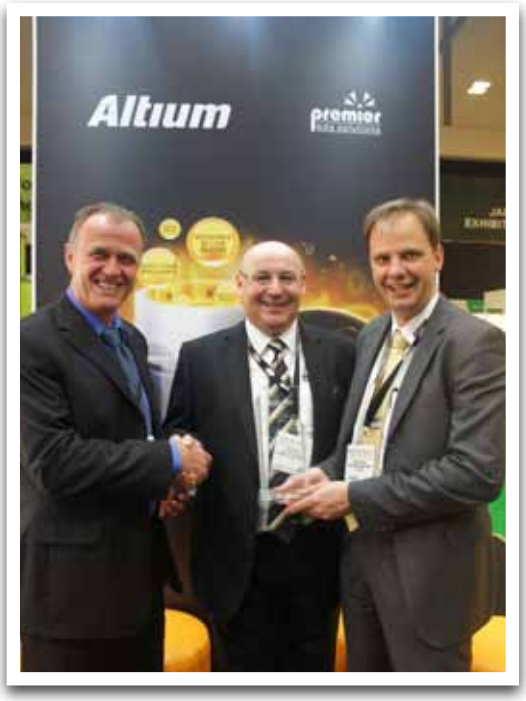
Outstanding success and passion of Premier EDA Solutions honoured at Electronics Design Show.

Altium's UK and Ireland channel partner Premier EDA Solutions has scooped the Altium EMEA reseller of the year award. Recognising Premier's exceptional commitment to the Altium user community in the UK and the significant growth achieved in the region, Altium presented the award to Managing Director Phil Mayo at the recent Electronics Design Show.

"Phil and his team at Premier set exceptionally high standards. Their commitment to customer success, extensive market knowledge and expert technical support for users of Altium's unified electronics design solutions makes for a powerful partnership," said Elmar Dukek, Senior Territory Manager, Altium.

During the company's 20 year history, Premier has won a plethora of awards from Altium and the wider electronics industry at large. This award in particular underlines the fact that Premier has broken sales targets and customer service expectations consistently for over a decade. It also pays tribute to Phil Mayo's extraordinary passion and engagement in supporting the UK electronics industry. Over the last few years Premier has invested in various sponsorship and free training programmes with a commercial value approaching £5M (R85m). These activities support schools, universities and other educational initiatives such as WorldSkills in a concerted effort to bring young people into the industry and ensure a bright future for UK electronics.

Alan Graham, Director of the UK based design services provider, Blackstick welcomed the news and commented: "As I've gotten to know Phil, I've seen how he has such a passion for the UK electronics industry. He makes us feel very proud for being part of the same industry and the Altium award is well-deserved."



From left to right:
Michael Leidel
(Channel Sales Manager EMEA, Altium),
Phil Mayo
(Managing Director, Premier EDA Solutions),
Elmar Dukek
(Senior Territory Manager, Altium)

Some exciting British design innovations developed with the aid of Premier and Altium Designer were showcased at the Electronics Design Show in Coventry last month. These included the solar-powered racing car Endeavour from Cambridge University Eco Racing and Angelic Bulldog, the streamliner aiming to break the world motorcycle land speed record of 400mph.

ALSTOM CONTINUES ITS EXPANSION IN SAUDI ARABIA AND WINS SEVERAL ORDERS WITH SAUDI ELECTRICITY COMPANY

Following the recent turnkey metro project in Riyadh and the supply of steam turbine generators for Shuqaiq power plant, the Group continues to expand its presence in the Kingdom of Saudi Arabia by producing and installing major equipment for the Saudi power grid, through its sustained relationship with Saudi Electricity Company (SEC), Saudi Arabia's electricity utility. Between July and November 2013, SEC has awarded Alstom Grid a total of nine contracts worth around 130 million euros. Saudi Arabia's electricity demand is currently rising at 8% per year, with extensive plans for industrial development by 2022, with six new major cities being built across the Kingdom.

This electricity demand is expected to reach 70 GW by 2020, against a current national generation capacity of 40 GW today. Alstom Grid, as leader in power transmission and grid development, is supporting the energy boom in the Kingdom of Saudi Arabia.

Stephane Cai, Alstom Grid Vice-President for the Near Middle East Region commented: *"Alstom has been present in Saudi Arabia for over 50 years and we're very proud that over 20% of the Kingdom's power is generated by Alstom equipment. This relationship is going one step further as we work hand in hand with SEC in their expansion of the national Saudi Grid".*

Alstom Grid has been present in Saudi Arabia for more than three decades.

COEGA PULLS OUT STOPS TO COMPLETE DCD WIND TOWER FACTORY ON TIME

Six months after breaking ground, the construction of the Coega Industrial Development Zone's (IDZ) first wind turbine manufacturing facility is on track to be completed in record time thanks to innovative and advanced engineering techniques used to fast track the process.

The wind turbine factory is more than 60% complete and the ambitious task undertaken by lead construction firm NMC to build the 23 000m² facility is nearing realisation, the Coega Development Corporation (CDC) said today.

The project is joint initiative between the DCD Group, the Industrial Development Corporation (IDC) and the CDC.

"The aim is to have the facility up-and-running in under 11 months after construction started in March, so that the DCD Group is able to supply its first two customers by February 2014," said Bruno Ponzo, CDC infrastructure project manager.

The facility is located in Zone 3 of the Coega IDZ and will be a first of its kind for the Eastern Cape.

According to Frans Namuhuya of WorleyParsons – provider of professional services to the resources and energy sectors and complex process industries – the next few months will "be tight" as they review the timeline to gain ground on time lost due to the construction industry strike.

"We have had to revise our schedule and increase the man hours and labour force to achieve our targets. We faced some challenges, but we also realised some noteworthy engineering feats that allowed us to fast track the project – such as the design, creation of shop drawings and manufacturing of steel that was cardinal to the successful delivery of the factory," said Namuhuya.

"The galvanised steel lattice column design used also allowed for a quick construction time considering the high speed nature of the project."

Once complete the DCD Wind Tower manufacturing facility will produce complete tubular steel towers, which entails the manufacture of the round steel tower sections from flat steel, welding flanges and assembling the inner parts of the towers.

DFR ENGINEERS SPONSORS CCTV SURVEILLANCE SYSTEM WORTH R 209 000

As expert consulting engineers in the electrical field, DFR Engineers decided to get their team involved by sponsoring a surveillance system in conjunction with ESS. The equipment is worth R160 000 and they sponsored the design and installation worth R49 000 – the project was completed on 25 October 2013 with a value of R209 000

Vissershoek primary school is a small school in an agricultural area – about 37km from Pretoria North. This school has 223 children and strongly believes that quality education forms a strong foundation towards a child's future.

This school and both parents as well as teachers are closely involved with the children's needs and academic as well as sport performance.

The school consists of small classes (about 29 children per class,) thus allowing the teachers to provide the children with personal attention.

All the classrooms as well as some outside areas and the gate area now have CCTV surveillance that are monitored in the principal's office. This new security system will not only improve the safety of both the children and the teachers, but also allow the school to provide a more disciplined environment to the kids. The system will ensure a low theft rate, controlled access to prevent intruders from entering the premises and also serve as proof should any incident happen at the school, ensuring a greater peace of mind to parents as well.

Various engineers and employees of DFR engineers as well and Anton from Vissershoek Primary School got involved with the installation of the system and cameras.

WATTSUP

SAIEE PLAYING A ROLE IN ADRESSING THE SKILLS GAP IN SA

From L-R: Veer Ramnarain (SAIEE KZN Chairman), Dr Faroon Goolam (ECSA Executive), Paul Van Niekerk (SAIEE President) and Dr Pat Naidoo (SAIEE Vice-President)

The engineering skills gap and the ill preparedness of graduates for the workplace has become common boardroom talk in the past decade. This is also used as a common reason for poor infrastructure development.

On the other end of the spectrum academia express great concern about the lack of support from industry for students when it comes to experiential learning and practical exposure.

With this in mind the South African Institute of Electrical Engineers (SAIEE) - KZN Centre had taken it upon them to bring both interested parties together at a Chairman's Workshop on 13 November 2013. The intension of the Chairman, Veer Ramnarain was to get a better understanding of where these views come from and to find a ways of bridging the gap between Industry, Academia, SAIEE and Engineering Council of South Africa (ECSA).

Leaders from major industries in KZN, Academia from Mangosuthu University of Technology, Durban University of Technology and University of Kwa-Zulu-Natal, as well as electrical engineering consultants were invited to the workshop. The Executive, which included from ECSA, Dr Faroon Goolam, President of SAIEE, Paul Van Niekerk and Vice President of SAIEE, Dr Pat Naidoo all gave presentations.

CONSULTANTS ACHIEVE LEVEL TWO STATUS

Consulting engineers Royal HaskoningDHV announce that they have achieved a Level 2 BEE Status.

An innovator from its early years, the company was one of the very first independent consulting engineering companies in Southern Africa and later, also one of the first to be established as an empowerment company.

Royal HaskoningDHV's strategic intent is to benefit all its stakeholders, believing that transformation initiatives are - as an underlying precept – about" doing good business" and recognising black economic empowerment as a business imperative that creates employment opportunities for the ultimate benefit of the country.

The firm has a long established reputation as a learning institution, stretching back to its origins in 1922.

More recently in 2007 the firm launched its Saturday School initiative which provides coaching for promising scholars from disadvantaged backgrounds to achieve a matric university pass, and go on to pursue a technical career.

Saturday School operates from six of the company's branch offices in Johannesburg, Pretoria, Cape Town, Bloemfontein, Durban and Pietermaritzburg and since inception has provided support for more than 800 learners.

Other learning based initiatives include participation in the CESA Job Shadow competition where over the past five years it has won the competition twice, been runners up twice and won the coveted Mentoring Company of the Year in 2011.

PIGS TO POWER HOMES

Organic waste from pigs on a farm in Leicestershire, UK, is helping to power an estimated 700 homes and reduce landfill waste by 18 000 tonnes each year.

The pig waste, combined with other food waste, is being used to produce biogas capable of generating the equivalent of around 1.2MW of electricity. The electricity is being exported onto the local energy grid used to power homes as well as the pig farming facility.

The technology used to convert waste into energy was designed and built by a UK company, PROjEN BioEnergy, who were honoured earlier this month by the Institution of Chemical Engineers (IChemE) at its annual award ceremony to celebrate innovation and excellence in chemical engineering across the world.

Using a process called anaerobic digestion – where natural bacteria are used to treat biodegradable materials – PROjEN's work has resulted in other major benefits.

The farm's carbon emissions have been reduced by offsetting electricity and heating consumption. Waste and by-products normally destined for landfill and incineration has been avoided.

In addition, the process produces a high quality pasteurised fertiliser, which is weed free and rich in nitrogen. Around 96 million tonnes[1] of farm manures are applied to agricultural land each year in the UK, with strict controls.

Pasteurisation helps to minimise the risks of food-borne diseases such as listeria and salmonella.

IChemE's chief executive, David Brown, said: *"The work of organisations like PROjEN shows the potential of chemical engineering to transform discarded waste into valuable commodities to benefit industries like farming. The benefits from just one farm are impressive. With an estimated four million pigs[2] in the UK alone, producing millions of tonnes of by-products each year, the potential for energy production, from a sustainable source, is significant".*

The role of chemical engineers in the energy sector is explored in IChemE's latest technical strategy, Chemical Engineering Matters.

The strategy also includes actions chemical engineers are taking on other global challenges including health, water and food.

VISION HEALTH MOBILE APP WON SAB FOUNDATION SOCIAL INNOVATIONS AWARDS

"Vula" Eye Health Mobile Phone App is the R1-million winner of the 3rd Annual SAB Foundation Social Innovation Awards held in Sandton, Johannesburg.

"Vula" Eye Health Mobile Phone App by innovators William Mapham and Professor Kovin Naidoo, aims to improve eye care in South Africa's low-income communities by educating people about different eye conditions, providing access to eye sight tests and connecting them to eye care professionals. The prize money will be used to grow and commercialise the product, which is aimed at making an impact amongst blind people in low income areas, with a focus on rural areas.

"There are more than 6.4 million people in South Africa who are blind or visually impaired simply because they cannot afford a pair of spectacles...this prevents them from amongst other getting a job. With the Vula app we hope to alleviate the plight of the blind and visually impaired," says Professor Naidoo.

Second place winner of R500 000 is Altis™ Osteogenic Bone Matrix, an injectable bone regeneration product developed by Nuno Pires. The grant will be used to help role the product out in local state hospitals as an affordable and less painful alternative to tradition bone graph procedures.

In joint third place with a grant of R300 000 each is ProYouth Naturals SNE Complex 54, body care products using medicinal African plants; SavvyLoo, a waterless toilet for rural and temporary settlements; and Repurpose Schoolbag, a schoolbag made of 100% recycled plastic shopping bags.

Professor Kovin Naidoo (left) and William Mapham (right) receiving their cheque for R1 million at the awards ceremony.

WATTSUP

SAIEE HISTORICAL SECTION HOSTS AWA AGM

Chairman of the Historical Section, Max Clarke (left) receiving the Fluke instrument from the outgoing President of the Gauteng Branch of the AWA, Richard Dismore.

The Antique Wireless Association of Southern Africa is made up of a group of active amateur radio enthusiasts with branches throughout Southern Africa. Their mission statements includes "... maintain interest in the location, acquisition, repair and use of yesterdays radios and associated equipment.....". Their Gauteng Branch recently held their Annual General Meeting in the SAIEE Council Chamber at Observatory and after the completion of formal business representatives of the SAIEE, lead by Vice President Andre Hoffman, were invited to join the meeting. The purpose was to inform the Institute that the AWA would support the establishment of the Innes House museum in whatever way possible and to cement the bond by the donation of an early model Fluke test instrument for future display in the Historical Section collection.

ALTIUM WINS EDN CHINA INNOVATION AWARD

Altium Designer 2013 wins Excellent Product of EDN China Innovation Award, which marks the sixth time in a row for Altium to win this award

Altium Limited, a global leader in Smart System Design Automation and provider of advanced 3D PCB design solutions (Altium Designer) and embedded software development (TASKING), has announced that Altium Designer 2013 has been honored with the Excellent Product in Development Tool and Software category of EDN China Innovation Award 2013. This year's award marks the sixth consecutive year that Altium has won in this category.

The EDN Innovation Award, which originated in Silicon Valley, is widely recognized as the most prestigious award in the micro-electronics field. Since 2005, EDN China has organized the Chinese version of the award annually to encourage innovation in product design, and help boost the rapid and long-term growth of China's electronics industry. This year, EDN China invited 500,000 engineers and online users to participate in online voting for the 2013 Innovation Awards. The selection process was comprised of three phases: nomination, online voting and expert identification to ensure professionalism, authority and fairness.

"It is a great honor for us to receive the EDN China Innovation award for the sixth consecutive year, and is further proof of Altium's ongoing spirit of innovation," said Max Cang, Marketing Manager of Altium China. *"The Altium team works tirelessly to perfect Altium Designer to ensure our customers have the best product to push the boundaries of traditional design. With Altium Designer, our end-users are better able to overcome design and data management challenges, while they leverage the latest technologies available in building next generation electronic products."*

IN MEMORIUM

A.S. MEYER
1931 - 2013

Allan S. Meyer

It is with deep regret that we record the death of Alan Meyer, a long standing member of the Institute, who passed to higher service on 26th November, 2013.

BY I MAX CLARKE

Alan was born in March 1931 at Kendal near Witbank and moved to Yeoville at a young age when his family re-located to the city. He graduated from Wits University in 1952 with a B.Sc in Electrical Engineering.

His early training included a spell at the Brush Electric Company, Loughborough, in the United Kingdom and after returning to South Africa he joined the First Electric Corporation – later to become GEC – where he specialised in the design of very large motors for mining and industrial purposes.

In the 1960's he developed a computational technique for designing electric motors which earned him a master's degree from his Alma Mata. He rose to become the Technical Director of GEC and eventually took early retirement to become a partner in a firm of Consulting Engineers.

After retiring from this company, Alan joined the staff of Wits University and was involved in teaching, mentoring and research projects, an interest he maintained after his formal retirement in an honorary capacity until a few months before his death.

Alan joined the SAIEE on the 6th of July 1951 and was elected a Fellow in December 1979. He served as SAIEE President in 1986 and represented the Institute on the Council of the Associated Scientific and Technical Societies for a number of years.

He was an active member of the Institute's various committees including the Historical Section which he joined in 2001 and was responsible for publishing a number of articles for journals and magazines on various artefacts held in the historical collection. He was also active on the committee that was responsible for supervising the construction of the new SAIEE House on the Observatory site.

He met his wife Ethne when they were both students at Wits and were married in 1956. The marriage bore two sons and a daughter.

On behalf of all his friends and colleagues in the Institute, we record deepest sympathy to Ethne and the children, grandchildren and the extended family. wn

Equipping Africa's Energy Future

POWER-GEN Africa and the inaugural DistribuTECH Africa have announced a formidable line-up of top international and local speakers for their 2014 conferences, which are now officially sanctioned as CPD (Continual Professional Development) events by the SAIEE (South African Institute of Electrical Engineers).

The 2014 conferences will run concurrently, alongside the power sector's premier expo, from 17-19 March at the Cape Town International Convention Centre.

They will attract African dignitaries and international energy experts from sub-Saharan Africa, the USA, UK, Germany, Italy, Russia and further afield, who will deliver their insights in a programme designed by an Advisory Board of African and international power industry experts.

In a comprehensive programme spanning five tracks across the co-located events, speakers will include South African Energy Minister Ben Martins, Eskom Group Executive Dr Steve Lennon, and Nampower Namibia Managing Director Paulinus Shilamba. Senior executives from key local players such as SASOL, Shell and Alstom will deliver talks or participate in in-depth panel discussions alongside high-ranking executives from top energy organisations from across the continent and the globe, including the Nigerian Presidential Task Force on Power, EDM Mozambique, the Ethiopian Power Corporation, Electricite de France, the Lesotho Highlands Water Commission and the African Development Bank, as well as respected academics and industry leaders.

Global event organisers PennWell report that more than 2100 attendees from 63 countries and six continents attended the inaugural POWER-GEN Africa 2012, and they expect the 2014 event to attract even larger numbers of high-level decision-makers and address key technology and development issues for the sub-Saharan Africa energy marketplace through a comprehensive educational programme and three-day exhibition.

The events will include two technical tours – to Eskom's new Centre for Substation Automation and Energy Management Systems (CSAEMS), Cape Town Peninsula University of Technology; and to Eskom's Ankerlig Power Station (previously known as the Atlantis OCGT power station), one of five gas turbine power plants in South Africa.

A series of Technical Training Workshops will also give delegates the unique opportunity to receive training in various categories of the generation, transmission and distribution fields.

"PennWell, as the biggest global event organiser in the power sector, is proud to be part of any new frontier or development, promising both business opportunity and the potential to transform lives. The current huge demand for the delivery of vital, secure energy services to the rapidly-

(From left) Mr Prince Moyo GM: Power Delivery Engineering at Eskom; Nigel Blackaby, PennWell Events Director; Dr Willie De Beer, industry expert and Chairman of the DistribuTECH Africa Advisory Board.

expanding economies across the African continent offers one such opportunity." says Nigel Blackaby, event director and director of conferences at the PennWell International Power Group, UK.

"POWER-GEN Africa and DistribuTECH Africa bring together power engineering planning and technology expertise from fuel supply, through power generation, right across the grid and down to the level of the customer's meter. All the elements that African utility companies are responsible for will be on show here, with the event being designed to be a meeting place to exchange views, discuss experiences and learn new ways to expand and strengthen the power industry across the many countries of Africa," says Blackaby.

In addition to the conference programme, POWER-GEN Africa and DistribuTECH Africa offer a substantial and world-class exhibition floor, playing host to a number of world-class suppliers and service providers, from home and abroad.

Those attending POWER-GEN Africa and DistribuTECH Africa will also be able to take part in free training workshops provided by leading suppliers and thereby enhance skill levels.

There are also two fascinating technical tours available to those who book in advance.

REGISTRATION & EARLY BIRD DISCOUNTS

Discounted Early Bird rates are available for Conference Delegates who register before 18 February 2014.

Registration can be completed online at: www.powergenafrica.com or www.distributechafrica.com.

Registering for one event provides access to both, including all conference sessions and entrance to the exhibition floor, plus all networking receptions. wn

KZN Centre Year-End Message

After having taken over the reins of the Kwa-Zulu Natal Centre in April 2013, the first priority was to compile an annual delivery plan for the committee. This highlights our goals and achievements we need to deliver to the 700 members of the KZN Centre.

BY I VEER RAMNARAIN
SAIEE CHAIRMAN KZN CENTRE

Knowing that the KZN Centre was established in 1957, and had been successfully run by all the previous Chairmen and committees, we felt obliged to uphold the success, and to deliver still more. To this end we set ourselves some very bold targets, but we knew that, with the contribution of industry and the members, failure was only a remote possibility.

As a committee we felt considered that we could add value for the members who are professionally registered with Engineering Council of South Africa (ECSA), by creating opportunities for them to attain CPD credits for Category 1: Developmental activities. A maximum of 4 credits may be accumulated annually under this category for attending Conferences, Congresses, Large group workshops, lectures, seminars, refresher courses and colloquiums. The committee planned to host 10 monthly-presentations giving members the opportunity to accumulate 1 CPD point for the year. The committee successfully hosted 9 presentations with which generated a total of 1.2 CPD point. Two of these presentations, namely the President's address and the Chairman's address were also delivered at the Pietermaritzburg satellite branch. The committee also planned to make available 3 courses contributing a total of 3 CPD points. In the 2013-year, 3 courses were held, one of which was sponsored and free, making available a total of 3.5 CPD points.

A presentation and site visit was arranged for the Hazelmere CPV green energy plant. Members who attended the monthly presentations and courses could have easily accumulated 4 CPD points in Category 1.

The success of the Centre depends largely on its membership. We had started the year with about 700 members and set ourselves a target to grow this to 750 members in two years. Despite the normal resignations, we had managed to grow our membership to 741 in less than a year. Considering that there are about 6000 members nationally, KZN contributes about 12.5% to the national membership. In the coming year we look forward to each all of the existing members retaining their membership of the SAIEE, and then growing the membership with their colleagues and friends. Some small gains have also been made in resurrecting the Student Chapters at Mangosuthu University of Technology, Durban University of Technology and University of Kwa-Zulu-Natal.

One aspect, which we felt needed attention, was that of our communication with the KZN membership. In order to improve the communication we introduced the electronic newsletter, "recharge" in May 2013 with our personal KZN branding.

Together with the December edition, we would have successfully distributed the newsletter to about 800 people for 8 months of the year. We wish to thank our sponsors who supported this initiative by means of their paid advertorials.

An aspect with which we grappled over the past few years was that of maintaining

current content on the previously outdated website. The SAIEE's new website launched in 2013, and the KZN-Centre's section is updated regularly for your benefit. Our plan is to start using other social media in the coming year, so as to keep you updated of on your Centre's activities.

We are grateful to The Daily News and The Mercury for the exposure they have given the KZN Centre. A number of significant activities of the Centre were covered in the media for the first time in recent years. Reporters willingly attended some key events and promptly published articles in the newsprint.

To play a more active role in the development of the profession, KZN Centre successfully hosted a Chairman's Workshop on 13 November 2013. Leaders from major industries in KZN, academia from Mangosuthu University of Technology, Durban University of Technology, and the University of Kwa-Zulu-Natal, as well as electrical engineering consultants were invited to the workshop. The Executives from ECSA, Dr. Faroon Goolam, President of SAIEE, Paul Van Niekerk and Vice President of SAIEE, Dr Pat Naidoo gave presentations. After the great enthusiasm expressed at the workshop, it was decided that a follow-up session would be held in 2014. We look forward to your support at this future workshop. Besides this workshop SAIEE – KZN Centre contributed at numerous other forums and platforms.

Overall, as a committee, we believe feel we have achieved most of what we set out to do in the past year. We have improved in some areas that needed attention and have laid the foundation for other areas that in which we may not have been as successful. Considering that the committee members are all volunteers, who give up many hours of their personal time attending meetings and arranging events, I believe they deserve a pat on the back.

To the members of SAIEE KZN – Centre, we say thank you for contributing to our profession and the development of our country. To our supporters, the sponsors, advertisers, media and presenters, thank you for helping to make 2013 a very successful year for the Centre.

SAIEE – KZN Centre wishes our members a safe and enjoyable festive season and a prosperous new year. It has been a great pleasure serving you in 2013. wn

South African Institute of Electrical Engineers
KZN SAIEE

First Clean Energy Connects to Grid

South Africans are now beginning to use renewable energy from the national grid. A solar power plant built by global energy provider Scatec Solar and local partners has become the first utility-scale renewable energy facility to supply electricity to Eskom after connecting to the grid three months ahead of schedule.

Officially opened on Tuesday 12 November, the 75 megawatt (MW) Kalkbult solar photovoltaic (PV) plant near Petrusville in the sun-drenched Northern Cape will generate 135 million kilowatt hours a year, equivalent to the annual electricity consumption of 33 000 households

It has been fully commissioned in 10 months, with construction commencing in late November 2012 and electricity delivery to the grid starting on September 27 2013.

"Today we are extremely proud to have been awarded this project under the ambitious South African REIPPPP programme, and proud that we are the first renewable energy plant to come on-line," said Raymond Carlsen, CEO of Norway-based Scatec Solar at the inauguration ceremony.

"Our teams worked literally day and night to make this happen. Suppliers made a huge effort to deliver their services and equipment, and local people who worked on the project were quick to learn despite the fact that many did not have previous experience in this kind of work."

The plant is among 47 solar, wind and mini-hydro projects awarded 20-year contracts to generate electricity under government's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). Total investment is estimated at R74 billion, which will climb above the R100bn mark following government's recent acceptance of 17 new bids.

Introduced by the Department of Energy three years ago, the REIPPPP supports South Africa's international commitments to combat climate change by reducing its near-total dependence on coal-based electricity and its high greenhouse gas emissions. The Kalkbult plant will avoid annual greenhouse gas emissions of 115 000 tons that would have been emitted by a fossil-fuelled plant, such as a coal-fired power station.

The project also gives momentum to the Green Economy Accord signed three years ago by government, business and labour with a goal to create 300 000 new jobs based on renewable energy generation, energy efficiency, biofuel production, manufacturing of equipment to support "green" projects, and natural resource conservation and rehabilitation. *"Access to energy is a prerequisite for increased standard of living. The only way we will be able to provide energy in a sustainable way to an increasing global population is by utilizing renewable energy sources,"* said Dr Alf Bjorseth, Chairman and founder of Scatec Solar. *"South Africa is showing the way, and we are looking forward to develop more solar projects with our partners here. I am convinced that the Kalkbult plant will benefit South Africa, both regionally and nationally,"* said Dr Bjorseth.

Equity in the project has been provided by Scatec Solar, which is the largest shareholder, Norfund, Simacel, Stanlib/ Standard Bank, and Old Mutual Life Assurance Company. Capital investment has been financed through Standard Bank. A certain part of the revenue from the Kalkbult facility and a portion of dividends has been earmarked to support social and economic development initiatives in communities within a 50 kilometre radius.

The Norwegian government also congratulated South Africa and Scatec Solar on the realization of this important project, both in terms of energy supply and the need for more clean energy. *"This is a great example of what can be achieved when the private sector and government work together to find solutions to pressing issues such as energy shortage and climate change,"* said State Secretary Paal Arne Davidesen at the Norwegian Ministry of Foreign Affairs. *"This solar plant is only the beginning. Hopefully we will see solar power being introduced on a major scale throughout Africa in the coming years."*

The Kalkbult plant covers 105 hectares of a working sheep farm and includes 312 000 solar panels mounted on 156 kilometres of substructure linked to inverters, transformers and a high voltage sub-station.

During peak construction periods, more than 600 employees - the majority from the local community – worked at the Kalkbult construction site, achieving more than 750 000 accident free hours. Some 16% of employees were women, who participated at all levels, from management and administration to construction activities.

The number of people employed will decline to between 10 and 15 during operations and maintenance, but this phase will be accompanied by *"a 20-year collaboration with local communities and the development of social and economic initiatives in areas such as education and health"* explains Carlsen.

The nearest town to the project is Petrusville, about 100 kilometres north east of De Aar on the N1. Land for the project has been leased from a sheep farmer who will continue to run his business alongside the solar PV facility. *"The fact that renewable energy can work in harmony with the environment and without disrupting surrounding activities is often overlooked,"* said Carlsen. *After 20 years, we can upgrade the project with the latest technology and continue operations for many years or we can dismantle it and leave the environment in its original natural state."*

Two other projects being developed by Scatec Solar and South African partners will improve on the Kalkbult plant's electricity generation performance, which is based on solar panels mounted at a fixed angle to the sun.

A 40MW plant near Hannover, also in the Northern Cape, and a 75MW plant near Burgersdorp in the Eastern Cape will have panels mounted on single axes, enabling them to track the sun and optimise electricity generation. Carlsen says the new plants, scheduled for commissioning during 2014, will be able to generate about 20% more electricity than fixed-panel plants.

Of the 47 renewable energy facilities contracted during the first two phases of the REIPPPP, 27 are solar PV plants that will have combined installed capacity of 1 048MW, with Scatec Solar providing 190MW. Scatec Solar has installed about 300MW of solar PV capacity worldwide. wn

Eskom partners with African Utility Week for next five years

Eskom will be the official host utility for the annual African Utility Week & Clean Power Africa conference and exhibition in Cape Town for the next five years.

Claire Volkwyn, content director for the African Utility Week, says South Africa is going through a shift in terms of its generation capacity by procuring and building renewable energy capacity through the country. She adds: *"additionally, by building our traditional generation capacity, we are ensuring South Africa's future generation mix is truly reflective of a combination of technologies.*

Eskom is actively involved in these efforts to ensure security of supply either through building the infrastructure, or through its role as purchaser of the power."

The next African Utility Week & Clean Power Africa is taking place at the CTICC in Cape Town, from 13-14 May 2014 and is attended by more than 5000 power and water professionals from more than 30 African countries and 70 worldwide, at what is the largest utility gathering of its kind on the continent.

Last year, Eskom Chief Executive Brian Dames once again was the keynote speaker, describing African Utility Week as *"an annual pilgrimage on the calendar of African electricity and water utilities, and as Eskom we are proud to have been a part of it for the past 13 years."*

African Utility Week's programme topics will include:

- Generation technologies – nuclear, coal, gas, geothermal and renewable energies such as solar and wind
- The role of the smart grid and what an African smart grid would look like
- HVDC technology for cross border transmission
- The role of prepaid metering for revenue management
- Can you have a smart grid which does not include a smart meter
- Updates on the South African REIPP programme
- Avoid another 2008 electricity supply crisis using world class manufacturing pillars
- Strike the balance in managing industrial and municipal water losses
- Outreach into the utility and energy intensive user industry

African Utility Week event director Russell Hughes said: *"As a Cape Town-based global trade exhibition & conference organiser responsible for the power and water industry's leading exhibition and conference in Africa, our vision is to partner with South Africa's power utility in a long term way that would support the objectives we share. These include continuously improving power supply and service to South African citizens and supporting stronger inter-collaboration amongst Africa's leading utilities."*

He continues: *"we are delighted that Eskom has approved a five year host utility agreement with African Utility Week, starting in 2014. It is encouraging to have Eskom's support for our outreach into the utility, large scale power and water user industries, and we intend to work closely with them in order to achieve greater levels of collaboration between African utilities and industry. We look forward to working with them for a very long time still."*

Eskom's Senior manager for Strategic Marketing Pieter Pretorius says in a statement: *"we are pleased that the endorsement of African Utility Week has been approved for period 2014-2018. We look forward to a continued partnership to benefit not only South Africa's energy industry and increased energy efficiency but also engaging with utilities, and service providers across the continent."*

Global utility service providers including Accenture, Symbion Power, Powertech, SMA, Landis+Gyr and Ernst & Young are also longstanding supporters of the event. wn

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Professor Elmissiry joins steering committee

Prof. Elmissiry joined NEPAD in June 2009 as an energy expert attending to regional energy projects, including electrical, renewable, oil and gas projects. He is currently heading NEPAD' Energy Programmes and to see to its full implementation.

Prof. Elmissiry held many senior positions in the past; amongst others the position of Director of the Energy Technology Institute, Industrial Research and Development Centre in Zimbabwe for seven years and Founding Dean of Botswana International University of Science and Technology.

He also held a professorial chair in electrical engineering and the position of Head of Electrical Engineering Department at the University of Zimbabwe in 2005.

He has published over a hundred papers in refereed journals and conference proceedings and co-authored three books in electrical engineering .

Prof Elimissery has been heavily involved in electrical engineering higher education and research across the African continent for over thirty years. He has been consulting to many international organizations and regional energy industries. His current position requires him to play a leading role in developing and facilitating the implementation of regional energy projects using NEPAD's machineries.

Prof. Elmissiry is a member of the Africa Energy Indaba Steering Committee 2014 and part of the panel of members at the conference covering the topic "Regional Interconnection." wn

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Think of the most frustrating, intractable, or simply annoying problems you can imagine. Now think about what technology is doing to fix them. That's what we did in coming up with our annual list of 10 Breakthrough Technologies. We're looking for technologies that we believe will expand the scope of human possibilities.

COMPILED BY | MINX AVRABOS

Our definition of a breakthrough is simple: an advancement that gives people powerful new ways to use technology. It could be an intuitive design that provides a useful interface (see "Smart Watches") or experimental devices that could allow people who have suffered brain damage to once again form memories ("Memory Implants"). Some could be key to sustainable economic growth ("Additive Manufacturing" and "Supergrids"), while others could change how we communicate ("Temporary Social Media") or think about the unborn ("Prenatal DNA Sequencing"). Some are brilliant feats of engineering ("Baxter"). Others stem from attempts to rethink longstanding problems in their fields ("Deep Learning" and "Ultra-Efficient Solar Power"). As a whole, I intend this annual list not only to tell you which technologies you need to know about, but also to celebrate the creativity that produced them.

1. DEEP LEARNING

- By Robert D. Hof

With massive amounts of computational power, machines can now recognize objects and translate speech in real time. Artificial intelligence is finally getting smart.

When Ray Kurzweil met with Google CEO Larry Page last July, he wasn't looking for a job. A respected inventor who's become a machine-intelligence futurist, Kurzweil

wanted to discuss his upcoming book *"How to Create a Mind"*. He told Page, who had read an early draft, that he wanted to start a company to develop his ideas about how to build a truly intelligent computer: one that could understand language and then make inferences and decisions on its own.

It quickly became obvious that such an effort would require nothing less than Google-scale data and computing power. *"I could try to give you some access to it,"* Page told Kurzweil. *"But it's going to be very difficult to do that for an independent company."* So Page suggested that Kurzweil, who had never held a job anywhere but his own companies, join Google instead. It didn't take Kurzweil long to make up his mind: in January he started working for Google as a director of engineering. *"This is the culmination of literally 50 years of my focus on artificial intelligence,"* he says.

Kurzweil was attracted, not just by Google's computing resources, but also by the startling progress the company has made in a branch of Artificial Intelligence (AI) called Deep Learning. Deep-learning software attempts to mimic the activity in layers of neurons in the neocortex, the wrinkly 80 percent of the brain where thinking occurs. The software learns, in a very real sense, to recognize patterns in digital representations of sounds, images, and other data.

The basic idea - that software can simulate the neocortex's large array of neurons in an artificial "neural network" - is decades old,

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and it has led to as many disappointments as breakthroughs. Because of improvements in mathematical formulas and increasingly powerful computers, computer scientists can now model many more layers of virtual neurons than ever before.

With this greater depth, they are producing remarkable advances in speech and image recognition. Last June, a Google deep-learning system that had been shown 10 million images from YouTube videos proved almost twice as good as any previous image recognition effort at identifying objects such as cats. Google also used the technology to cut the error rate on speech recognition in its latest Android mobile software.

In October, Microsoft Chief Research Officer, Rick Rashid wowed attendees at a lecture in China with a demonstration of speech software that transcribed his spoken words into English text with an error rate of 7 percent, translated them into Chinese-language text, and then simulated his own voice uttering them in Mandarin. That same month, a team of three graduate students and two professors won a contest held by Merck to identify molecules that could lead to new drugs. The group used deep learning to zero in on the molecules most likely to bind to their targets.

Google in particular has become a magnet for deep learning and related AI talent. In March the company bought a start-up co-founded by Geoffrey Hinton, a University of Toronto computer science professor who was part of the team that won the Merck contest. Hinton, who will split his time between the university and Google, says he plans to *"take ideas out of this field and apply them to real problems"* such as image recognition, search, and natural-language understanding, he says. All this has normally cautious AI researchers hopeful that intelligent machines may finally escape the pages of science fiction. Indeed, machine intelligence is starting to transform everything from communications and computing to medicine, manufacturing, and transportation. The possibilities are apparent in IBM's Jeopardy!-winning Watson computer, which uses some deep-learning techniques and is now being trained to help doctors make better decisions. Microsoft has deployed deep learning in its Windows Phone and Bing voice search.

Extending deep learning into applications beyond speech and image recognition will require more conceptual and software breakthroughs, not to mention many more advances in processing power. We probably won't see machines we all agree can think for themselves for years, perhaps decades - if ever. But for now, says Peter Lee, head of Microsoft Research USA, *"deep learning has reignited some of the grand challenges in artificial intelligence."*

2. TEMPORARY SOCIAL MEDIA

- By Jeffrey and Christine Rosen

Messages that quickly self-destruct could enhance the privacy of online communication and make people feel freer to be spontaneous.

One essential aspect of privacy is the ability to control how much we disclose to others. Unfortunately, we've lost much of that control now that every photo, chat, or status update posted on a social-media site can be stored in the cloud: even though we intended to share that information with someone, we don't necessarily want it to stay available, out of context, forever. The weight of our digital pasts is emerging as the central privacy challenge of our time.

But what if people could make their posts vanish automatically - making social media more of an analogue to everyday conversations that aren't recorded for posterity? That's the promise of services such as Snapchat, a mobile-phone app whose popularity has increased dramatically during the past year. Evan Speigel and Bobby Murphy, who met as undergrads at Stanford, came up with the idea two years ago, around the time New York congressman Anthony Weiner accidentally made racy photos of himself public on Twitter and was forced to resign. Snapchat lets users take photos or short videos and then decide how long they will be visible to the recipient. After 10 seconds or less, the images disappear forever. (Not for nothing is Snapchat's mascot a picture of a grinning ghost.)

From the beginning, the service appealed to teenagers looking for a more private way of sending each other sexy pictures. But "sexting" alone can't account for all 100 million photos and videos exchanged on Snapchat every day. And Mark Zuckerberg must worry that Snapchat addresses some misgivings people have about privacy on Facebook; in December, Facebook launched a Snapchat copycat app called Poke.

What makes temporary social media so appealing? Snapchat's founders often remark that they wanted to give people a way to express themselves through something besides the idealized self-portraits many feel required to maintain on social-media sites. Snapchat might be more exciting to send and receive than other social-

media posts because they are ephemeral, but they are also arguably a more natural way to communicate. Whereas Facebook and Twitter record and store your every offhand observation and casual interaction, interactions in temporary social media can be something like brief, in-person conversations: you can speak your mind without worrying that what you say will be part of your digital dossier forever.

Although Snapchat's posture as the anti-Facebook is a large part of its allure, eventually its founders will have to confront some of the same privacy challenges that have vexed Facebook. Snapchat contains an obvious technological vulnerability: images that were meant to vanish can still be saved if the recipient uses a screen-capture feature to take a picture of the message during the seconds it appears. (If the recipient does this, Snapchat notifies the sender, but by then it's too late to stop the image from being preserved and shared.) Moreover, while Snapchat promises to erase photos from its servers, the company's privacy policy adds that it *"cannot guarantee that the message data will be deleted in every case."*

As soon as a racy Snapchat picture of a celebrity goes viral, trust in the company could be eroded.

But regardless of the fate of Snapchat in particular, the idea of temporary social media is important because the ability to be candid and spontaneous - and to be that way with only some people and not others - is the essence of friendship, individuality, and creativity. Facebook and Twitter do make it possible for their members to wall off posts from the wider world and share them only with trusted people in certain circles. But since those posts still last forever, this capacity for limited sharing is technologically insecure. To the degree that temporary social networks increase our sense of control over the conditions of our personal exposure, they represent a first step toward a more nuanced kind of digital connection - one acknowledging that our desire to share can coexist with a desire for reticence, privacy, and the possibility of a fresh start.

3. PRENATAL DNA SEQUENCING

- By Antonio Regalado

Reading the DNA of fetuses is the next frontier of the genome revolution. Do you really want to know the genetic destiny of your unborn child?

Earlier this year, Illumina, the maker of the world's most widely used DNA sequencing machines, agreed to pay nearly half a billion dollars for Verinata, a start-up in Redwood City, California, that has hardly any revenues. What Verinata does have is technology that can do something as ethically fraught as it is inevitable: sequence the DNA of a human foetus before birth.

Verinata is one of four U.S. companies already involved in a rapidly expanding market for prenatal DNA testing using Illumina's sequencers. Their existing tests, all launched in the last 18 months, can detect Down syndrome from traces of fetal DNA found in a syringe-full of the mother's blood. Until now, detecting Down syndrome has meant grabbing foetal cells from the placenta or the amniotic fluid, procedures that carry a small risk of miscarriage.

The non-invasive screen is so much safer and easier that it's become one of the most quickly adopted tests ever and an important new medical application for Illumina's DNA sequencing instruments, which have so far been used mainly in research labs. In January, Illumina's CEO, Jay Flatley, told investors that he expects the tests will eventually be offered to as many as two million women a year in the United States, representing half of all pregnancies - up from around 250,000 mothers, mostly older, who now undergo the invasive tests.

"It's unprecedented in medical testing how fast this has gone from lab research to acceptance," says Diana Bianchi, executive director of the Mother Infant Research Institute at Tufts University and the chief clinical advisor to Verinata. *"It's a huge impact for any technology in its first year."*

This is likely to be just the start for prenatal DNA sequencing. The same labs and companies that launched the Down syndrome tests, like Verinata, have also figured out how they can get much more information from a mother's bloodstream, including the complete genome sequence of her foetus. That's a technical breakthrough, and maybe a commercial one, too. Pregnancy, with its hopes, anxieties, and frequent doctor's visits, could be where genome sequencing finally finds a major consumer application.

"I think that we are going to sequence the genome of everyone - of every foetus- in the first trimester, at least in part," says Arthur Beaudet, a paediatrician and head of human genetics at the Baylor College of Medicine, in Houston. Today some patients have their genomes sequenced to shed light on genetic diseases or illnesses like cancer, but one-day people won't wait until they're sick. "*We are already going to know the data at birth,*" he says.

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4. ADDITIVE MANUFACTURING

- By Martin LaMonica

The world's largest manufacturer GE, is on the verge of using 3-D printing to make jet parts.

General Electric is making a radical departure from the way it has traditionally manufactured things. Its aviation division, the world's largest supplier of jet engines, is preparing to produce a fuel nozzle for a new aircraft engine by printing the part with lasers rather than casting and welding the metal. The technique, known as additive manufacturing (because it builds an object by adding ultrathin layers of material one by one), could transform how GE designs and makes many of the complex parts that go into everything from gas turbines to ultrasound machines.

Additive manufacturing - the industrial version of 3-D printing - is already used to make some niche items, such as medical implants, and to produce plastic prototypes for engineers and designers. The decision to mass-produce a critical metal-alloy part to be used in thousands of jet engines is a significant milestone for the technology. While 3-D printing for consumers and small entrepreneurs has received a great deal of publicity, it is in manufacturing where the technology could have its most significant commercial impact.

Last year, GE purchased a pair of companies with know-how in automated precision manufacturing of metals and then folded the technology into the operations of GE Aviation. That group doesn't have much time to demonstrate that its new technology can work at scale. CFM International, GE's joint venture with France's Snecma, will use the 3-D-printed nozzles in its LEAP jet engine, due to go into planes in late 2015 or early 2016 (CFM says it already has commitments of R220 billion). Each engine will use 10 to 20 nozzles; GE needs to make 25,000 of the nozzles annually within three years.

GE chose the additive process for manufacturing the nozzles because it uses less material than conventional techniques. That reduces GE's production costs and, because it makes the parts lighter, yields significant fuel savings for airlines. Conventional techniques would require welding about 20 small pieces together, a labour-intensive process in which a high percentage of the material ends up being scrapped. Instead, the part will be built from a bed of cobalt-chromium powder.

A computer-controlled laser shoots pinpoint beams onto the bed to melt the metal alloy in the desired areas, creating 20-micrometer - thick layers one by one. The process is a faster way to make complex shapes because the machines can run around the clock. Additive manufacturing in general conserves material because the printer can handle shapes that eliminate unnecessary bulk and create them without the typical waste.

The rest of GE - together with its competitors - is watching closely. GE Power & Water, which makes large gas and wind turbines, has already identified parts it can make with the additive process, and GE Healthcare has developed a method to print transducers, the expensive ceramic probes used in ultrasound machines. *"It's really fundamentally changing the way we think about the company,"* says Mark Little, GE's chief technology officer.

Breaking with traditional manufacturing techniques, such as casting and machining material, gives GE product designers far greater flexibility. Additive manufacturing machines work directly from a computer model, so people can devise completely new shapes without regard for existing manufacturing limitations. *"We can make configurations that we just couldn't before,"* Little says.

GE engineers are starting to explore how to use additive manufacturing with a wider range of metal alloys, including some materials specifically designed for 3-D printing. GE Aviation, for one, is looking to use titanium, aluminium and nickel-chromium alloys.

A single part could be made of multiple alloys, letting designers tailor its material characteristics in a way that's not possible with casting. A blade for an engine or turbine, for example, could be made with different materials so that one end is optimized for strength and the other for heat resistance.

All that is still on paper - or rather, in the computerized designs of product engineers. For now, GE's engine nozzle - a part small enough to fit in the palm of your hand - will be the first big test of whether additive manufacturing can revolutionize the way complex high-performance products are made.

5. BAXTER: THE ROBOT

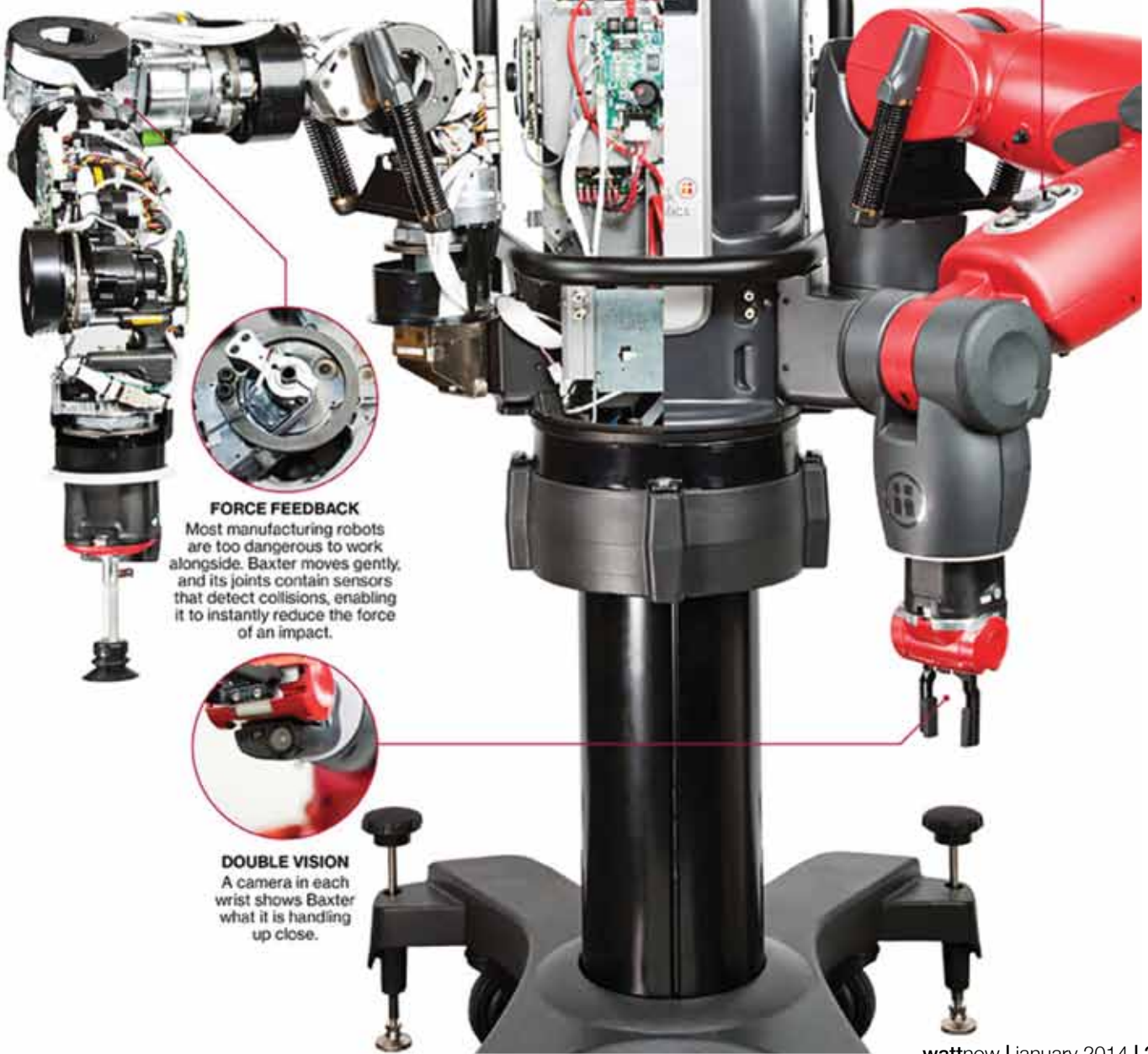
- By Will Knight

Rethink Robotics' new creation is easy to interact with, but the innovations behind the robot show just how hard it is to get along with people.

THE EXPRESSION SAYS IT ALL
Baxter's face indicates its status and where its attention is focused. It can also sense the location of people nearby, thanks to a ring of sonar sensors around its crown.

HANDS-ON TRAINING
Workers teach Baxter to perform a task by moving its arms, but they can access more features using dials and buttons on its forearms.

CENTRAL COMMAND
Baxter costs far less than most industrial robots, in part because its software runs on an ordinary personal computer, which is embedded in its chest.



FORCE FEEDBACK
Most manufacturing robots are too dangerous to work alongside. Baxter moves gently, and its joints contain sensors that detect collisions, enabling it to instantly reduce the force of an impact.

DOUBLE VISION
A camera in each wrist shows Baxter what it is handling up close.

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6. MEMORY IMPLANTS

- By Jon Cohen

A maverick neuroscientist believes he has deciphered the code by which the brain forms long-term memories.

Theodore Berger, a biomedical engineer and neuroscientist at the University of Southern California in Los Angeles, envisions a day in the not-too-distant-future when a patient with severe memory loss can get help from an electronic implant. In people whose brains have suffered damage from Alzheimer's, stroke, or injury, disrupted neuronal networks often prevent long-term memories from forming. For more than two decades, Berger has designed silicon chips to mimic the signal processing that those neurons do when they're functioning properly - the work that allows us to recall experiences and knowledge for more than a minute. Ultimately, Berger wants to restore the ability to create long-term memories by implanting chips like these in the brain.

The idea is so audacious and so far outside the mainstream of neuroscience that many of his colleagues, says Berger, think of him as being just this side of crazy. *"They told me I was nuts a long time ago,"* he says with a laugh, sitting in a conference room that abuts one of his labs. Given the success of recent experiments carried out by his group and several close collaborators, Berger is shedding the loony label and increasingly taking on the role of a visionary pioneer.

Berger and his research partners have yet to conduct human tests of their neural prostheses, but their experiments show how a silicon chip externally connected to rat and monkey brains by electrodes can process information just like actual neurons. *"We're not putting individual memories back into the brain,"* he says. *"We're putting in the capacity to generate memories."* In an impressive experiment published last year, Berger and his co-workers demonstrated that they could also help monkeys retrieve long-term memories from a part of the brain that stores them.

If a memory-implant sounds farfetched, Berger points to other recent successes in neuro-prosthetics. Cochlear implants now help more than 200,000 deaf people hear by converting sound into electrical signals and sending them to the auditory nerve. Meanwhile, early experiments have shown that implanted electrodes can allow paralyzed people to move robotic arms with their thoughts. Other researchers have had preliminary success with artificial retinas in blind people.

Still, restoring a form of cognition in the brain is far more difficult than any of those achievements. Berger has spent much of the past 35 years trying to understand fundamental questions about the behaviour of neurons in the hippocampus, a part of the brain known to be involved in forming memory. *"It's very clear,"* he says. *"The hippocampus makes short-term memories into long-term memories."*

What has been anything but clear is how the hippocampus accomplishes this complicated feat. Berger has developed mathematical theorems that describe how electrical signals move through the neurons of the hippocampus to form a long-term memory, and he has proved that his equations match reality. *"You don't have to do everything the brain does, but can you mimic at least some of the things the real brain does?"* he asks. *"Can you model it and put it into a device? Can you get that device to work in any brain? It's those three things that lead people to think I'm crazy. They just think it's too hard."*

7. SMART WATCHES

- By John Pavlus

The designers of the Pebble watch realized that a mobile phone is more useful if you don't have to take it out of your pocket.

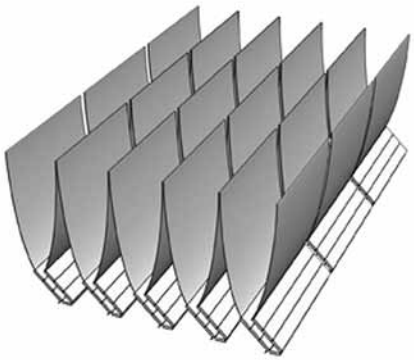
Eric Migicovsky didn't really want a "wearable computer." When he first conceived of what would become the Pebble smart watch five years ago, as an industrial-design student at Delft University of Technology in the Netherlands, he just wanted a way to use his smartphone without crashing his bicycle. *"I thought of creating a watch that could grab information from my phone,"* the 26-year-old Canadian says. *"I ended up building a prototype in my dorm room."*

Now Migicovsky is shipping 85,000 Pebble watches to eager customers who don't want to lug a glass slab out of their pocket just to check their e-mail or the weather forecast. Pebble uses Bluetooth to connect wirelessly to an iPhone or Android phone and displays notifications, messages, and other simple data of the user's choosing on its small black-and-white LCD screen. In

April 2012, using the online fund-raising platform Kickstarter, Migicovsky asked for $100,000 to help bring Pebble to market. Five weeks later, he had more than $10 million - making his the highest-grossing Kickstarter campaign yet. Suddenly smart watches are a real product category: Sony entered the market last year, Samsung is about to, and Apple seems likely to follow.

Although the R1 500 Pebble watch can be used to control a music playlist or run simple apps like RunKeeper, a cloud-based fitness tracker, Migicovsky and his team purposely designed the watch to do as little as possible, leaving more complicated apps for phones. This emphasis on making the watch "glance-able" informed nearly every aspect of the design. The black-and-white screen, for example, can be read in direct sunlight and displays content persistently without needing to "sleep" to conserve battery power, as colour or touch-screen displays do.

These watches are coming to market a few months before Google Glass, which is another attempt to solve the problem Pebble addresses - namely, that "*interacting with our phones has a certain overhead that doesn't need to be there,*" says Mark Rolston, chief creative officer of Frog Design. Google Glass will try to replace the smartphone altogether by combining a computer and monitor into eyeglass frames so that wearers can "augment" their view of the world with data. That lines up with predictions about the advent of wearable computing, but it's easy to see Pebble's idea being much more popular. By making use of a watch - a classic accessory - Pebble is trying to fit in to long-standing social norms rather than create new ones.



8. ULTRA-EFFICIENT SOLAR POWER

- By Mike Orcutt

Doubling the efficiency of solar devices would completely change the economics of renewable energy. Here is a design that just might make it possible.

Harry Atwater thinks his lab can make an affordable device that produces more than twice the solar power generated by today's panels. The feat is possible, says the Caltech professor of materials science and applied physics, because of recent advances in the ability to manipulate light at a very small scale.

Solar panels on the market today consist of cells made from a single semiconducting material, usually silicon. Since the material absorbs only a narrow band of the solar spectrum, much of sunlight's energy is lost as heat: these panels typically convert less than 20 percent of that energy into electricity. The device that Atwater and his colleagues have in mind would have an efficiency of at least 50 percent. It would use a design that efficiently splits sunlight, as a prism does, into six to eight component wavelengths—each one of which produces a different colour of light. Each colour would then be dispersed to a cell made of a semiconductor that can absorb it.

Atwater's team is working on three designs. In one (see illustration), for which the group has made a prototype, sunlight is collected by a reflective metal trough and directed at a specific angle into a structure made of a transparent insulating material. Coating the outside of the transparent structure are multiple solar cells, each made from one of six to eight different semiconductors. Once light enters the material, it encounters a series of thin optical filters. Each one allows a single colour to pass through to illuminate a cell that can absorb it; the remaining colours are reflected toward other filters designed to let them through.

Another design would employ nano-scale optical filters that could filter light coming from all angles. A third would use a hologram instead of filters to split the spectrum. While the designs are different, the basic idea is the same: combine conventionally designed cells with optical techniques to efficiently harness sunlight's broad spectrum and waste much less of its energy.

It's not yet clear which design will offer the best performance, says Atwater. The devices envisioned would be less complex than many electronics on the market today, he says, which makes him confident that once a compelling prototype is fabricated and optimized, it could be commercialized in a practical way.

Achieving ultra-high efficiency in solar designs should be a primary goal of the industry, argues Atwater, since it's now *"the best lever we have"* for reducing the cost of solar power. That's because prices for solar panels have plummeted over the past few years, so continuing to focus on

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making them less expensive would have little impact on the overall cost of a solar power system; expenses related to things like wiring, land, permitting, and labour now make up the vast majority of that cost. Making modules more efficient would mean that fewer panels would be needed to produce the same amount of power, so the costs of hardware and installation could be greatly reduced. *"Within a few years,"* Atwater says, *"there won't be any point to working on technology that has efficiency that's less than 20 percent."*

9. BIG DATA FROM CHEAP PHONES

- By David Talbot

Collecting and analysing information from simple cell phones can provide surprising insights into how people move about and behave - and even help us understand the spread of diseases.

At a computer in her office at the Harvard School of Public Health in Boston, epidemiologist Caroline Buckee points to a dot on a map of Kenya's western highlands, representing one of the nation's thousands of cell-phone towers. In the fight against malaria, Buckee explains, the data transmitted from this tower near the town of Kericho has been epidemiological gold.

When she and her colleagues studied the data, she found that people making calls or sending text messages originating at the Kericho tower were making 16 times more trips away from the area than the regional average. What's more, they were three times more likely to visit a region northeast of Lake Victoria that records from the health ministry identified as a malaria hot spot. The tower's signal radius thus covered a significant waypoint for transmission of malaria, which can jump from human to human via mosquitoes. Satellite images revealed the likely culprit: a busy tea plantation that was probably full of migrant workers. The implication was clear, Buckee says. *"There will be a ton of infected people there."*

This work is now feeding into a new set of predictive models she is building. They show, for example, that even though malaria cases were seen at the tea plantation, taking steps to control malaria there would have less effect on the disease's spread than concentrating those efforts at the source: Lake Victoria.

That region has long been understood as a major centre of malaria, but what hasn't been available before is detailed information about the patterns of human travel there: how many people are coming and going, when they're arriving and departing, which specific places they're coming to, and which of those destinations attract the most people travelling on to new places.

Existing efforts to gather that kind of travel data are spotty at best; sometimes public-health workers literally count people at transportation hubs, Buckee says, or nurses in far-flung clinics ask newly diagnosed malaria victims where they've been recently. *"At many border crossings in Africa, they keep little slips of paper - but the slips get lost, and nobody keeps track,"* she says. *"We have abstractions and general models on travel patterns but haven't been able to do this properly - ever."*

The data mining will help inform the design of new measures that are likely to include cheap, targeted campaigns of text messages - for example, warning visitors entering the Kericho tower's signal zone to use bed netting. And it will help officials choose where to focus mosquito control efforts in the malarial areas. *"You don't want to be spraying every puddle for mosquito larvae all the time. But if you know there is a ton of importation from a certain spot, you want to increase your control program at that spot,"* Buckee says. *"And now I can pinpoint where the importation of a disease is especially important."*

10. SUPERGRIDS

By Kevin Bullis

A high-power circuit breaker could finally make DC power grids practical. High-voltage DC power lines can efficiently transport electricity over thousands of kilometres and for long distances underwater, outperforming the AC lines that dominate transmission grids now. But for a century, AC prevailed because high-voltage DC could be used only for point-to-point transmission, not to form the integrated grid networks needed for a stable electricity system.

The Swiss conglomerate ABB has solved the main technical hurdle to such grids. It has developed a practical high-voltage DC circuit breaker that disconnects parts of the grid that have a problem, allowing the rest to keep working.

DC grids would be more efficient at connecting far-flung sources of renewable energy, allowing utilities to average out local variations in wind and solar power while bringing power to areas without much sunshine or wind. Solar power from the Sahara could power cloudy Germany, and wind power from all over Europe could keep the lights on at night. The result: more reliable renewable energy that can better compete with fossil fuels. wn

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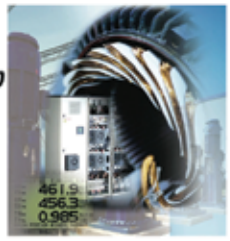

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Benefits of Cloud Management

Information systems (IS) and information technology (IT) are transforming many aspects of our lives, including how we work and conduct business.

BY I GINO BOUGAARDT I **PR. ENG.** I **MSAIEE**

S/IT can form an integral part of the operations of an organization: e.g. Enterprise Resource Planning (ERP) systems. In the case of ERP systems, they link various business units of an organization such as financial, accounting, manufacturing, inventory, distribution, transportation, logistics, procurement, human resources etc. into a tightly integrated single system. The aim of investing in these and other IT systems is for the investment to add value to the business - be it reducing costs, increasing business process efficiency and effectiveness or creating a new capability that provides a competitive advantage [13].

However, IT investments can add a significant financial burden to the budgets of organizations especially if they are operating under severe financial constraints. Consequently, IT managers find it increasingly hard to justify rising IT expenditure. IT managers normally need to justify the contribution that the investments will make to the business performance. The justification process involves evaluating IT investments. IT evaluation methods are both quantitative and qualitative in nature. However, many organizations apply traditional quantitative accountancy (financial) frameworks, which have weaknesses [9].

Furthermore, and more importantly, IT managers must ensure that the potential business benefits, as planned for at the proposal stage of the IT project, are actually realized [8]. A successful investment is one that delivers theexpected benefits to the organisation. Herein, lies the challenge. IT investments are not being consistently translated into business benefits. It is not merely enough to identify (the "what") the potential benefits upfront. This alone will not make them happen. In addition to this, attention must be given to how the potential benefits are to be realised[14]. It is the "what" and the "how" that forms part of the skill of benefits management.

The purpose of this article is to present popular quantitative IT evaluation methods and to discuss their shortcomings. The focus is to show that organizations should embrace benefits management in their IT evaluation processes. Furthermore, a refocus of benefits management with regard to the cloud computing IT investment is addressed. This article will be of value to IT practitioners and managers that seek to understand benefits management in IT evaluation processes. Benefits management is crucial to the success of the IT investment.

This article begins by discussing the challenges of the financial IT evaluation methods. The next section discusses the context of benefits management. Thereafter, a section on the benefits management approach in cloud computing is discussed. Finally conclusions are drawn.

WEAKNESSES IN FINANCIAL IT EVALUATION METHODS

Popular financial IT evaluation methods used in organizations are Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR) and Cost Benefit Analysis (CBA) amongst others.

In many oorganizations, because of the organizational structure, culture, processes and policies, the Chief Information Officer (CIO) or IT manager has to motivate for funding to the Chief Financial Officer (CFO) or financial manager. The CFO/ financial manager is normally only interested in the monetary (i.e. NPV, ROI, IRR and CBA) aspect of an IT project. To justify an IT investment using these methods is fairly simple. However, they have weaknesses.

The NPV discounts future cash flows to the present value and utilizes the discount rate

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to which it is very sensitive. Hence, blindly following the NPV>0 (positive NPV) decision rule that would advise whether to invest now can be incorrect. The NPV approach does not consider the option of waiting to implement the project under which market conditions can change. Changing market conditions brings with it new information that has to be factored into the investment decision-making. The NPV does not provide for this [1].

Even if the NPV is calculated for different time points corresponding to changing markets, the discount rate has to be estimated for each of the time points and the NPV is sensitive to discount rates. The ROI and IRR are useful to decision makers since they compare the estimated returns of different investments. The higher the financial gain the better the investment. However, the weakness of the ROI, IRR and CBA is that good investment possibilities can be withdrawn because the benefits were difficult to assess in monetary terms [4].

Benefits can be classified as either tangible or intangible and both need to be considered. Tangible benefits can be easily measured, monitored and controlled and hence financial values can be attributed to them. However, intangible benefits are difficult to measure, monitor and control and therefore it is difficult to assess the financial value of them[8; 9].

THE CONTEXT OF BENEFITS MANAGEMENT

A benefit is an outcome that is considered positive to an organization. Benefits can be positive and expected or unexpected. They can also be negative and unexpected (dis-benefits). The dis-benefits have an adverse impact on the organization. Benefits management (BM) is defined as the "process of organizing and managing such that the potential benefits arising from an IS/IT investment in change are actually achieved." The BM process encompasses the complete life cycle of the IT project including before and after project implementation. It is an ongoing process, not only until successful delivery, but as long as benefits can be derived from the IT project [3;15].

Generally, organizations do not monitor whether the desired benefits were realized and a few reasons for this are: Firstly, they find difficulty in assessing the benefits after the implementation of the project. They lack the expertise and the tools to monitor the benefits. Secondly, they regard monitoring as irrelevant if the IT project was delivered successfully. The focus is on managing the deliverables rather than the benefits. Thirdly, organizations view the post-implementation benefit review as a costly exercise. Fourthly, it is against organizational culture to act as both a benefits implementer and a watchdog. Finally, there is an inadequate recognition of the intangible benefits. Intangible benefits are normally unplanned or unexpected benefits [2; 8].

Unexpected benefits make it difficult to create a comprehensive list of the future benefits at the start of the BM process. This is presented in figure 1 where identifying and structuring benefits is the start of the cyclic process [9; 15].

During the first phase the IT project's benefits and penalties are identified, along with suitable measures for each benefit for the purpose of tracking the performance once implemented. Furthermore, a stakeholder analysis identifies the relevant business managers that are affected by the changes and benefits to be implemented. It is important to the success of the project that the relevant business managers buy-in and agree to the benefits list. Phase two

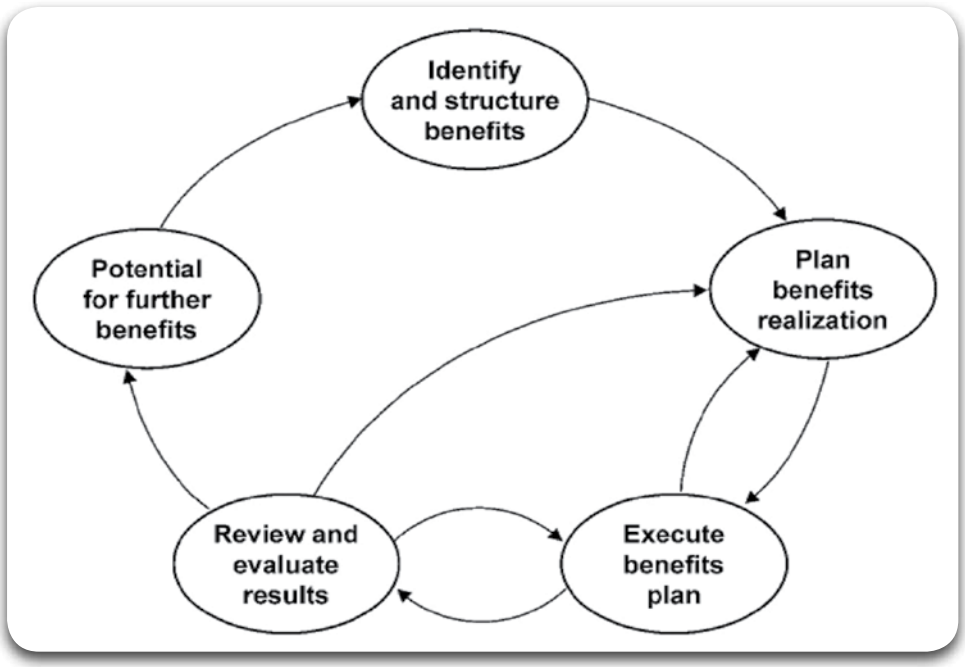

Figure 1: The Cranfield Process Model of Benefits Management [15]

(plan benefits realization) and phase three (execute benefits plan) are the core phases of the project management discipline within the benefits management process (figure 2). During phase two the business owners who are responsible for the delivery of the benefits are identified.

This includes planning and assessing the business changes that are required to realize the benefits. At this stage the project's viability is determined and funding approved, once the benefits plan is produced. The execution of the benefits plan (phase three) firstly ensures the implementation of the necessary business changes needed, which in turn enables the implementation of the benefits plan.

It is important to continually monitor the implementation of the business changes, through change management, as since they can enable or disable the delivery of benefits from the benefits plan. Moreover, the benefits plan can be revised accordingly should issues or new benefits emerge during the implementation of the business changes. Once the business changes and benefits are fully implemented they are reviewed and evaluated (phase four) after some time according to the business measures established during phase one.

Phase five (potential for further benefits) addresses benefits that were overlooked during phase one of the BM process. It is often difficult to identify all of the benefits of an IT project in advance. It is much easier to identify further potential benefits after an IT project is fully implemented and has been in operation for some time. Identifying further potential benefits restarts (phase one) the iterative BM process again [10; 15].

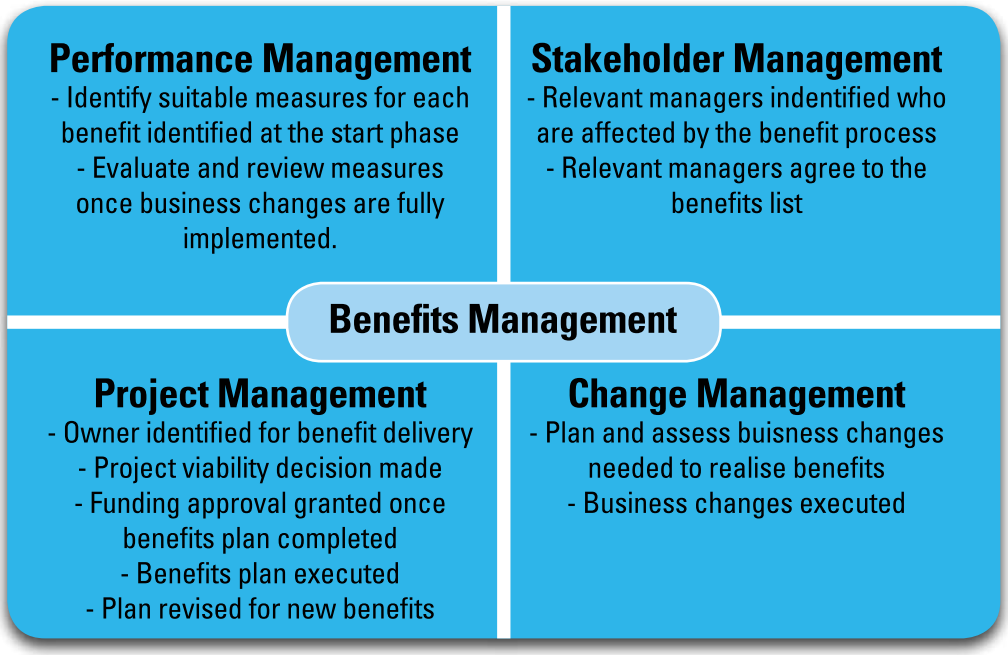

Figure 2: Benefits Management relationship with other management disciplines

From another perspective, the BM process can be viewed through the lens of mainly four management disciplines combined (i.e. performance, stakeholder, project and change management) as presented in figure 2 [3]. The core activities described in the BM process can be classified under one of the four management disciplines.

Change management is a discipline that is at the core of the BM process and of any change initiative. Investing in the cloud-computing paradigm is a change initiative that can introduce significant changes to a business, as it is a new model of computing and provisioning services via the Internet.

The cloud computing service models are Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS). The BM process, which incorporates change management, should be essential in provisioning services from the cloud. However, there should be a re-focus of BM as the cloud service, accessed from a cloud service provider via the Internet, is external to the organization's IT department. Consequently, an organization may find it challenging monitoring ongoing benefits derived from the cloud. The challenge of monitoring benefits makes performance management difficult.

BENEFITS MANAGEMENT APPROACH IN THE CLOUD COMPUTING INVESTMENT

Performance management, in the context of benefits management, in essence refers to activities that ensure benefits are consistently being met in an effective and efficient manner. From a cloud computing perspective the focus of performance management is on the drivers/benefits for adopting cloud computing and the service level agreement (SLA) with the cloud service provider.

Figure 3 lists a few well known benefits and SLA considerations that could potentially be monitored[7; 12].

Benefits of Cloud Computing

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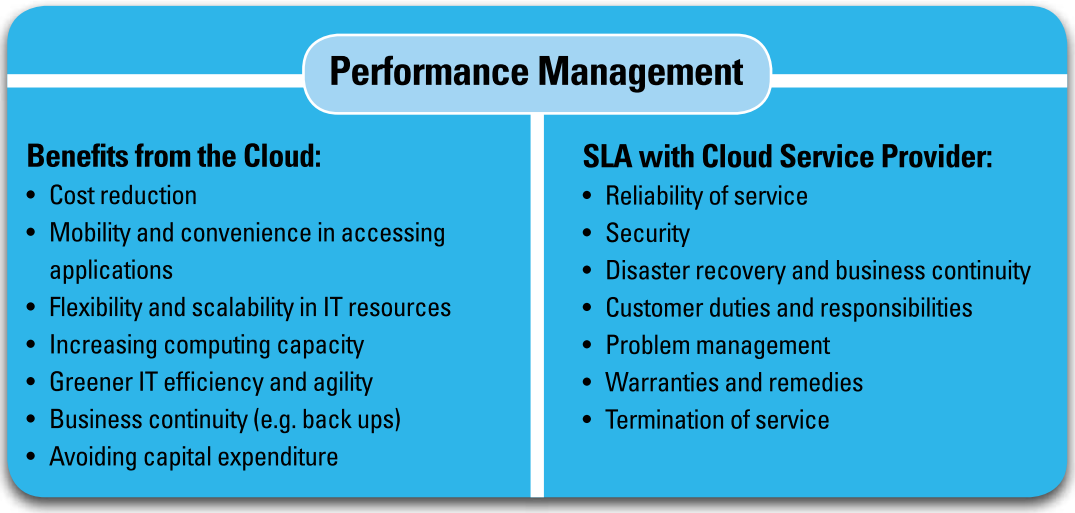

Figure 3: Performance Management in the cloud

The SLA is a legal document that defines the relationship between a provider (cloud service provider) and the consumer (cloud consumer) covering issues related to for e.g. reliability of service, security, disaster recovery etc. with the aim to monitor performance levels. However, well-defined SLAs are a scarcity and it is further complicated when cloud consumers rely on multiple cloud service providers that offer different levels of guarantees (e.g. reliability of service) [5; 7].

Furthermore, composite services which are cloud services that are composed through nesting and layering with other cloud services can become a serious problem with regard to liability (i.e. SLA responsibilities, warranties and remedies) and performance guarantees. Composite services can arise when cloud service providers subcontract services to third-party cloud service providers. For e.g. a SaaS cloud service provider can build its service upon that of a PaaS or IaaS service from another cloud service provider [6]. A benefit of this composite services arrangement for a SaaS cloud service provider is that it can avoid large capital outlays that purchase and manage software and hardware.

Avoiding large capital outlays is one of the main drivers/benefits for organisations adopting cloud computing (figure 3). Organisations can outsource capital intensive IT services and applications such as hosting services, email services, backup services, data storage, booking systems etc. to the cloud[12]. Moreover, the cloud pay-as-you-go costing/metering model reduces the cost of transacting since the cloud consumer is charged according to the resources they consume.

The performance of the cloud pay-as-you-go model is difficult to monitor for cloud consumers because of the attributes of cloud computing (i.e. hardware virtualisation and multitenancy). Cloud consumers have little to no visibility into the cloud infrastructure. Consequently, cloud consumers cannot directly connect their actual cloud resource consumption with their usage charges. Furthermore, hardware virtualisation and multitenancy allows multiple cloud consumers to share and scale the same IT resources on the cloud infrastructure which gives the cloud its power,however, software bugs and network congestion can possibly cause cloud service providers to incorrectly bill cloud consumers. Cloud service providers need to develop tools that meter usage fairly in the interest of both the cloud provider and the cloud consumer [11]. On the other hand, organisations need to develop processes and tools that can enable internal cloud benefits monitoring and tracking. Furthermore, a governance board in the organisation, having cloud oversight,can monitor the performance of the SLAs and have the power to approve, change or terminate cloud subscriptions.

CONCLUSION

IT investments can add a significant financial burden to the budgets of organizations. Hence it is important to justify the investments. Popular financial methods such as NPV, ROI, IRR and CBA are used in evaluating investments. Although these financial evaluation methods are fairly

simple to implement they have weaknesses, amongst others, the benefits are difficult to assess in monetary terms. The discipline of benefits management can aid in this process. However, when it comes to the cloud computing IT investment a refocus of benefits management is required since the cloud computing investment is external to the organization. IT department. Consequently, performance management of the cloud benefits and the SLA with the cloud service provider is important. Organizations need to develop tools and processes to monitor and track internal cloud benefits whereas a governance board is required to have cloud oversight in respect of managing SLAs with the cloud service providers. wn

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A Path to Topology

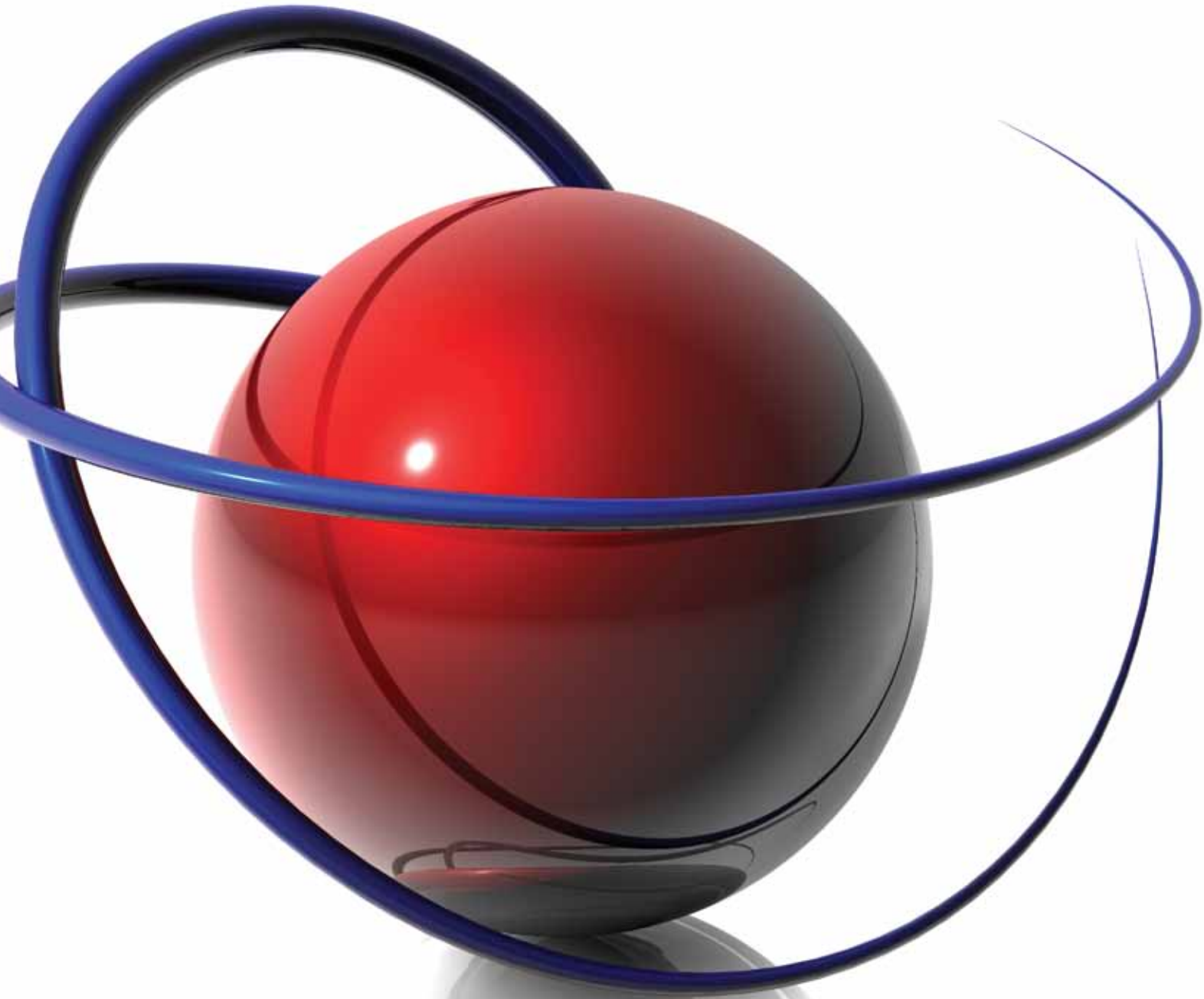
The huge branch of mathematics known as topology is a natural extension to classical geometry, but a geometry in which size or angles play no part at all would have seemed strange indeed to the ancient Greeks. Topology also makes a break from Euclidean space by reaching to higher dimensions which are beyond human visualization. This is not purely abstract work – the higher dimensional manifolds of geometric topology are essential to studies of the ultimate particles of matter and the dimensionality of space.

BY | DUDLEY BASSON

Swiss born mathematician Leonhard Euler (1707-1783) is considered by many to be the most prolific mathematical writer of all time – it scarcely seems credible that all of his achievements could have been crammed into a single lifetime. Euler integrated the differential calculus of Leibniz and Newton's fluxions into mathematical analysis.

He made significant contributions to pure and applied mathematics including calculus of variations, analysis, number theory, algebra, geometry, trigonometry analytical mechanics, acoustics, hydrodynamics and lunar theory. The general appearance and notation of mathematics as we know it today are largely due to Euler. Students seeing for the first time the wonderful vistas opened up by complex number theory may be inclined to think: "*Wow – this is something new!*" but this was a stroke of genius by Euler two and a half centuries ago. His famous complex number equation linking exponential functions to trigonometric functions is a triumph of mathematical brilliance.

The original definition of the complex number concept $i^2 = -1$ comes to us from Rafaello Bombelli (1526-1572). Euler's famous equation $e^{i\pi} = -1$ is the straight-line real number case of $e^{ix} = \cos x + i \sin x$. Two-dimensional complex numbers were extended by mathematician Sir William Rowan Hamilton to four-dimensional quaternions with the multiplication identity $i^2 = j^2 = k^2 = ijk = -1$.



Maxwell's original electromagnetic equations were expressed as twenty quaternion equations in twenty variables. Every engineering student will be familiar with Euler's formula for the buckling load of a slender column. Euler made an early contribution to topology when he discovered that for any simple polyhedron the number of faces plus the number of vertices minus the number of edges gave the invariant value of 2. This is known as the Euler characteristic of a polyhedron. By increasing the number of faces until the polyhedron becomes a sphere the characteristic remains the same. Other polyhedra with holes or internal cavities will have other characteristic values. In topology a sphere and a cube or other polyhedron are equivalent. In geometric topology the entities under consideration are known as manifolds – these can be lines, areas, solids or abstract objects in higher dimensions. Trivial examples are a cup and saucer. The saucer, not having any holes, can be morphed into a sphere or other lump. The part of the cup that can contain a liquid is not significant as

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this can be morphed away. The ear of the cup has a hole through it so that the cup can be morphed into a lump with a hole right through. A more complex object is a teapot. The hole at the top and the spout are not significant as these can be morphed away. The significant features are the hole through the handle and the holes for filtering tealeaves that might enter the spout. A topology joke: a topologist cannot tell the difference between a sphere and a cube or between a mug and a doughnut.

Geometric topology is not simply a matter of playing with modeling clay – manifolds can be in higher dimensions beyond human visualization and the mathematics involved is fiendishly difficult. In a three dimensional space only five regular polyhedra are possible, which are known as the Platonic solids. A very familiar geometric object is the polyhedral pattern soccer ball. This is a truncated regular icosahedron. The icosahedron has twenty triangular surfaces and twelve vertices. When the vertices are truncated they form twelve pentagons and the triangles are truncated to twenty hexagons. This shape is nearly spherical so it takes little stretching to inflate it to a sphere. A soccer ball typically has black pentagons and white hexagons.

Using Euler's algebra also shows that a polyhedron of pentagons and hexagons will have twelve pentagons. A seemingly intuitive theorem, the hairy ball problem, states that it is impossible to brush all the hair on a ball flat without causing a cowlick. This may seem intuitive but the algebraic proof is daunting. A cowlick is the circular pattern of hair produced when a cow licks its new-born calf. Another interesting topological object is the Möbius loop. This is a loop of tape with a twist so that it has only one surface and only one edge. An interesting branch of geometric topology is the study of mathematical knots. These are different to those known to every sailor and Boy Scout in that the strands and braids are always closed loops. An interesting aspect of three dimensional knots is that they fall apart in higher dimensions. As a trivial example draw two circles on a piece of paper, the one inside the other. In two dimensions it is impossible to separate the circles without cutting the outer circle. In three dimensions however you can simply lift the inner circle and take it away.

When approached by Carl Ehler, mayor of the town of Danzig, to solve the Königsberg bridge problem, Euler initially thought the problem beneath the notice of a mathematician. The picturesque town of Königsberg in Prussia (now Kaliningrad, Russia) consisted of four regions, two on either side of river Pregel and two islands, which were all connected by seven bridges. Ehler required a route, which could take tourists to all four regions and cross each bridge only once. Euler soon realized that the logic would require a new branch of mathematics, algebraic topology, and was able to solve the problem, where algebraically possible, for any number of regions and bridges.

In the Königsberg case a solution was not possible. Euler reduced the problem to a schematic diagram of nodes and connections and extended the problem for a possible return to the starting point and also a preset order for passing through the nodes. This is generally regarded as one of the first treatises on modern topology. A similar situation can be found on the London Tube map. The original maps were based on street maps which were cumbersome to use. The topological map now used by every visitor to London is a colour coded schematic diagram similar to an electrical wiring diagram. Euler's algebraic topology provides a useful tool for electric circuit analysis.

Euler was fortunate in obtaining his original mathematical tuition from the famous professor Johann Bernoulli. He joined the St. Petersburg Academy in 1727 where he was in an exceptional environment surrounded by the most eminent scientists of the day. He was appointed to the senior chair of mathematics when it was vacated on the departure of Daniel Bernoulli. Euler was not only a theoretician but undertook considerable practical tasks such as hydraulic engineering projects, fire engines, magnetism, ship building, and served as advisor to the government on state lotteries, insurance, annuities, pensions and artillery. Euler also served as medical lieutenant in the Russian navy from 1727 to 1730. Euler produced his phenomenal output of work despite losing the sight of his right eye in 1735 and that of his left eye in 1766. Catherine the Great referred to Euler as her 'cyclops mathematician'. It is a testament to Euler's genius that the great French mathematician Laplace told his students: *"Read Euler, read Euler, he is our master in everything"*.

Jean Baptiste Joseph Fourier (1768-1830) made major advances in the mathematical study of heat flow. In 1822 he published his major work Théorie analytique de la chaleur. He could have had no idea that his 'Fourier series' would have profound implications for electrical engineering a century later. This provides the explanation of how a voltage wave that has been clipped can produce a series of harmonics. This

has become even more prominent with the introduction of variable speed drives for AC motors which can produce unwanted or even harmful harmonics. Variable speed drives can reach gigantic proportions, even powering the huge propulsion pods of ocean liners. A fire was caused on board the Queen Mary 2 when a capacitor of an 11kV harmonic filter failed. The use of AC traction motors with variable speed drives has become widespread on railways. Another major byproduct of Fourier's work was the theory of Ricci Flow, somewhat similar to heat flow, which would provide a vital component to the proof of Poincaré's famous topology conjecture two centuries later.

Fourier was enthusiastically supportive of the French Revolution and joined the local Revolutionary Committee. Developments caused him to change his mind but citizen Fourier found that withdrawing from politics was a life threatening exercise. He was twice arrested and released and even thought that he would be sent to the guillotine. Pleas, possibly by Lagrange, colleagues and students resulted in his being able to walk free. Fourier provided a useful service to Napoleon by determining the maximum rate at which cannons could be continuously fired without overheating.

Fourier joined the large delegation of scientists and other experts that accompanied Napoleon's invasion of Egypt. He remained in Egypt for three years working as a governor before returning to France. He took with him an ink impression of the Rosetta stone which Champollion was able to use to decipher the Egyptian hieroglyphics. Fourier also contributed to the monumental work: Description de l'Egypte. Napoleon's ambitions in Egypt were thwarted by the British Navy under the command of Vice Admiral Horatio Nelson who destroyed or captured nearly the whole of Napoleon's warship fleet. The most horrific event of the battle was the destruction of the magnificent French flagship l'Orient which was blown to smithereens when the powder magazines exploded. The flagstaff of l'Orient was salvaged and kept as a souvenir by Nelson at his home in Merton.

Mathematician George Cantor (1845-1918) is renowned for his work on set theory, number theory and the topological Cantor space. He made use of the Fourier series in his topological work. Poincaré was outraged by Cantor's idea of 'transfinite numbers'.

Other mathematicians who made major contributions to topology were: Listing, Gauss, Hilbert and Riemann.

Jules Henri Poincaré (1854-1912) showed exceptional mathematical ability from a young age. In addition to studying mathematics he also studied thermodynamics to an advanced level. His doctoral thesis on differential equations was under the supervision of the renowned mathematician Hermite. Poincaré also obtained a mining degree and worked for a time as a mining engineer at a coal mine. He was commended for his prompt and humane handling of a mine disaster. For his meticulous report he used forensic methods to trace the exact location and cause of the explosion.

Poincaré made huge contributions to mathematics, physics, celestial mechanics, fluid mechanics and is also regarded as an originator of algebraic topology and chaos theory. He made a major contribution to the famous three body orbiting problem. Newton despaired of solving the problem saying: *"This exceeds, if I am not mistaken, the force of any human mind"*. In 1887, King Oscar II of Sweden announced a competition for the solving of the three body problem. On awarding the prize to Poincaré, mathematician Weierstrass declared: *"This work cannot indeed be considered as furnishing the complete solution of the question proposed, but that it is nevertheless of such importance that its publication will inaugurate a new era in the history of celestial mechanics."* When studying the three body problem Poincaré discovered a chaotic aspect as well as aperiodic orbits.

Mathematician Lagrange had also studied the three body problem and in 1772 published a paper showing that there are five points associated with a planetary orbit where small bodies can remain in a stable position while orbiting as a whole with the planet. These are known as the Lagrangian points of an orbit and are of vital importance to space missions. The first three points had been documented earlier by Euler.

Poincaré is regarded with Einstein and Lorentz as one of the originators of the Special Theory of Relativity.

In 1904, Poincaré proposed his famous topological conjecture which he left to the mathematicians of this planet to find a proof which would make his conjecture a theorem - a task which would defy the efforts of mathematicians for a century. This was something of a Lorelei siren luring mathematicians like Rhine sailors to their doom. Mathematicians who attempted the

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problem were said to be afflicted with poincaritis. The eventual proof was posted on the Internet in 2002-2003 by Grigori Yakovelovich Perelman. The Perelman proof relied heavily on Ricci flow which had its origins with Fourier two centuries earlier. Perelman had to use Ricci flow with surgery to remove singularities which would otherwise have bedevilled his proof. Perelman also acknowledged his indebtedness to the work of mathematician Richard Hamilton.

The original concise 68 page proof was re-written as a 473 page paper by mathematicians Morgan and Tian to make the proof more accessible to other mathematicians and students. To the astonishment of the mathematical world, Perelman declined the prestigious Fields Medal and million dollar Clay Millennium Prize, preferring to remain in relative obscurity and poverty.

On reading the actual conjecture, the proof appears as a trivial task – much like the Last Theorem of Fermat, which looks like a simple extension to the theorem of Pythagoras, but appearances can be very deceptive. Fermat's theorem remained unproven for 358 years despite his claim that he had proved it himself.

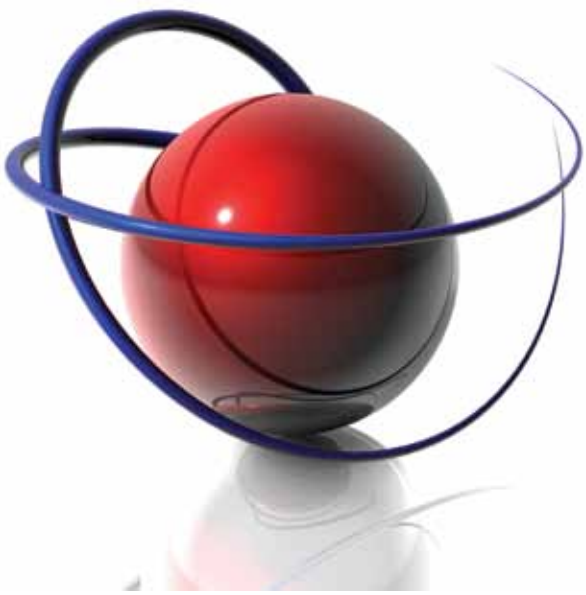
A comment from Sir Arthur Stanley Eddington: *Proof is the idol before whom mathematicians torture themselves.*

Calabi-Yau manifolds are important in superstring theory of particle physics. In the most conventional superstring models, ten conjectural dimensions in string theory are supposed to come as the four of which we are aware. There are several non-equivalent definitions of Calabi-Yau manifolds. The theoretical physics work on string theory manifolds and space dimensionality appear to be moving closer to a most bizarre investigation made more than a century ago in 1895 – well before particle physics became established as a science, and even the existence of atoms was not yet universally accepted. This was a psychic investigation of the hydrogen atom.

The investigation showed the proton nucleus enveloped in an orbital, the proton containing three smaller charged objects (quarks) linked by forces in a triangle and the quarks each containing three small manifolds, each consisting of ten string loops twisted together, the loops consisting of spiral filaments.

Curiously, the quarks were shown to be enveloped in small orbitals, which would need to be of gamma wavelength size. The term quark (to rhyme with bark) denoting the component parts of hadrons was coined in 1964 by Murray Gell-Mann, taking the word from the writing of author James Joyce.

Topology and the theoretical physics which relies heavily on it have come a long way but the end is nowhere in sight. The gigantic collider at CERN was shut down in February 2013 for an €82 million upgrade which will double its beam particle energy to 14 TeV. This will require the replacement of 10 000 electrical connectors, installation of 5 000 insulators, 10 170 leak tests and 18 000 electrical tests. We can expect great things to come. wn



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"Decades of Engineering Excellence" is a 216 page hardcover prestige coffee table publication of the Engineering Council of South Africa.

"Decades of Engineering Excellence"

Engineering is the discipline, skill, and profession of acquiring and applying scientific, technical, economic, social, environmental and practical knowledge, in order to design, build and maintain structures, machines, devices, systems, materials and processes. It may encompass using insights to conceive, model and scale an appropriate solution to a problem or objective. The discipline of engineering is extremely broad, and encompasses a range of more specialized fields of engineering, each with a more specific emphasis on particular areas of technology, and types of application.

The American Engineers' Council for Professional Development (ECPD) has

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Sesotho sa Leboa	Boinjenere
Sesotho	Boinjenere
Setswana	Boinjenere
siSwati	Bunjiniyela
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Xitsonga	Injiniyeringi

defined "engineering" as:
The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilising them singly or in combination; or to construct or operate the same with full cognisance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.

South Africa has eleven official languages. The table above shows the English word "engineering" translated into all in the other ten languages.

CATEGORIES OF ENGINEERING PRACTITIONERS IN SOUTH AFRICA

One who practices engineering is called an engineering practitioner, and is a member of one or more of the four categories in the family of engineering practitioners, namely:

- Certificated Engineer;
- Engineer;
- Engineering Technician; and
- Engineering Technologist.

All categories of engineering are made up of a number of disciplines and sub disciplines of engineering.

THE MAIN DISCIPLINES OF ENGINEERING

Engineering is a broad discipline which is broken down into several sub disciplines. These disciplines concern themselves with differing areas of engineering work. Although initially an engineering practitioner will usually be trained in a specific discipline, throughout an engineering practitioner's career he may become multi-disciplined, having worked in several of the outlined areas. Globally, engineering is characterised by the following nine main disciplines:

1. Agricultural
2. Aerospace incl. aeronautical
3. Chemical
4. Civil
5. Electrical
6. Industrial
7. Mechanical
8. Metallurgical
9. Mining

OTHER MAIN AND SUB DISCIPLINES OF ENGINEERING

Beyond the above nine main disciplines, sources vary on other main and sub disciplines of engineering.

The following are acknowledged:

- Biomedical
- Computer
- Electro-mechanical
- Electronic
- Marine
- Mechatronic
- Military
- Naval
- Nuclear

THE HISTORY OF ENGINEERING

Engineering has existed since ancient times, as humans devised fundamental inventions such as the pulley, lever and wheel. Each of these inventions is consistent with the modern definition of engineering, exploiting basic mechanical principles to develop useful tools and objects.
The term engineering itself has a much more recent etymology, deriving from the word engineer, which itself dates back to 1325, when an engineer (literally, one who operates an engine) originally referred to 'a constructor of military engines'. The word 'engine' itself is of even older origin, ultimately deriving from the Latin ingenium (c. 1250), and meaning 'innate quality, especially mental power, hence a clever invention'.

ENGINEERING THROUGH THE AGES: ANCIENT, RENAISSANCE, MODERN

Examples of engineering in the ancient era include the pyramids in Egypt, the Hanging Gardens of Babylon, the Acropolis and the Parthenon in Greece, the Roman aqueducts, Via Apia and the Colosseum, Teotihuacán and the cities and pyramids of the Mayan, Inca and Aztec Empires, the Great Wall of China, the Brihadeshwara temple of Tanjavur and tombs of India to name but a few. The earliest civil engineer known by name is Imhotep. As one of the officials of the Pharaoh, Djoser, he probably designed and supervised the construction of the Pyramid of Djoser at Saqqara in Egypt around 2630-2611 BC.

During the Renaissance Era William Gilbert, considered to be the first electrical engineer published De Magnete in 1600 and coined the term 'electricity'; the first steam engine was built in 1698 by mechanical engineer Thomas Savery; and with the rise of engineering as a profession

Decades of Engineering Excellence

continues from page 53

in the eighteenth century, the term became more narrowly applied to fields in which mathematics and science were applied.

Since early 1800, during the modern era of engineering, all disciplines of engineering developed rapidly and still do.

The first PhD in engineering (technically, applied science and engineering) awarded in the United States of America went to Willard Gibbs at Yale University in 1863; it was also the second PhD in science in the U.S.

METHODOLOGY IN ENGINEERING

Methodologies such as engineering design, engineering problem solving, the use of computers in engineering and engineering in a social context, applies to all categories and disciplines of engineering.

Engineering is a key driver of human development. Sub-Saharan Africa, in particular, has a very small engineering capacity. This results in many African nations being unable to develop crucial infrastructure without outside aid. The attainment of many of the Millennium Development Goals (MDG) of the United Nations requires the achievement of sufficient engineering capacity to develop infrastructure, and sustainable technological development. The MDGs are eight international development goals which were officially established following the Millennium Summit of the United Nations in 2000, and the adoption of the United Nations Millennium Declaration.

All 193 United Nations member states, and at least 23 international organisations have agreed to achieve these goals by 2015. The goals are:

- Eradicating extreme poverty and hunger;
- Achieving universal primary education;
- Promoting gender equality;
- Reducing child mortality rates;
- Improving maternal health;
- Combating HIV/AIDS, malaria, and other diseases;
- Ensuring environmental sustainability; and
- Developing a global partnership for development.

All overseas development and relief non-governmental organisations (NGOs) make considerable use of engineering practitioners to apply solutions in disaster and development scenarios.

These organisations aim to use engineering directly for the good of mankind:

- Engineers without Borders;
- Engineers against Poverty;
- Registered Engineers for Disaster Relief;
- Engineers for a Sustainable World;
- Engineering for Change;
- Engineering Ministries International.

RELATIONSHIPS OF ENGINEERING WITH OTHER DISCIPLINES

Science

Scientists study the world as it is; engineers create the world that has never been — Theodore von Kármán, 1881 - 1963, Aerospace Engineer

There exists an overlap between the sciences and engineering practice; in engineering, one applies science. Both areas of endeavor rely on accurate observation of materials and phenomena. Both use mathematics and classification criteria to analyse and communicate observations.

Scientists may also have to complete engineering tasks, such as designing experimental apparatus or building prototypes. Conversely, in the process of developing technology engineers sometimes find themselves exploring new phenomena, thus becoming, for the moment, scientists.

In the book *What Engineers Know and How They Know It,* Walter Vincenti,(1917 – present), aerospace engineer, asserts that engineering research has a character different from that of scientific research.

First, it often deals with areas in which the basic physics and/or chemistry are well understood, but the problems themselves are too complex to solve in an exact manner.

Examples are the use of numerical approximations to the Navier-Stokes equations to describe aerodynamic flow over an aircraft, or the use of Miner's rule to calculate fatigue damage. Second, engineering research employs many semi-empirical methods that are foreign to pure scientific research, one example being the method of parameter variation.

As stated by Fung (1919 – present), bio engineer et al. in the revision to the classic engineering text, Foundations of Solid Mechanics:

"Engineering is quite different from science. Scientists try to understand nature. Engineers try to make things that do not exist in nature. Engineers stress invention. To embody an invention the engineer must put his idea in concrete terms, and design something that people can use. That something can be a device, a gadget, a material, a method, a computing program,

an innovative experiment, a new solution to a problem, or an improvement on what is existing. Since a design has to be concrete, it must have its geometry, dimensions, and characteristic numbers.

Almost all Engineers working on new designs find that they do not have all the needed information. Most often, they are limited by insufficient scientific knowledge. Thus they study mathematics, physics, chemistry, biology and mechanics. Often they have to add to the sciences relevant to their profession. Thus engineering sciences are born."

Although engineering solutions make use of scientific principles, engineers must also take into account public safety, efficiency, life cycle economy, reliability, constructability or ease of fabrication, quality management, risk management and legal considerations such as patent infringement, or liability, in the case of failure of the solution.

Medicine and Biology

The study of the human body is an important common link between medicine and some engineering disciplines. Medicine aims to sustain, enhance and even replace functions of the human body, if necessary, through the use of technology.

Modern medicine can replace several of the body's functions through the use of artificial organs and can significantly alter the function of the human body through artificial devices such as, for example, brain implants and pacemakers.

The fields of Bionics and medical Bionics are dedicated to the study of synthetic implants pertaining to natural systems.

Conversely, some engineering disciplines view the human body as a biological machine worth studying, and are dedicated to emulating many of its functions by replacing biology with technology. This has led to fields such as artificial intelligence, neural networks, fuzzy logic, and robotics. There are also substantial interdisciplinary interactions between engineering and medicine.

Medicine, in part, studies the function of the human body. The human body, as a biological machine, has many functions that can be modelled using engineering methods.

The heart for example functions much like a pump, the skeleton is like a linked structure with levers, the brain produces electrical signals, etc.

These similarities and the increasing importance and application of engineering principles in medicine, led to the development of the field of biomedical engineering that uses concepts developed in both disciplines.

Engineering and Art

There are connections between engineering and art; they are direct in some fields, for example, architecture, landscape architecture and industrial design (even to the extent that these disciplines may sometimes be included in a University's Faculty of Engineering); and indirect in others.

Among famous historical figures Leonardo Da Vinci is a well-known Renaissance artist and engineer, and a prime example of the nexus between art and engineering.

GREATEST ENGINEERING ACHIEVEMENTS OF THE 20TH CENTURY

In 2003, the National Academy of Engineering in the United States of America published "*A Century of Innovation: Twenty Engineering Achievements that transformed our Lives*". This work detailed historical information on a list of what the authors consider to be the top twenty engineering achievements of the 20th century, or those achievements which had the greatest impact upon life during and following this period.

The list of the 20 was published as follows:

- Electrification;
- Automobile;
- Airplane;
- Water Supply and Distribution;
- Electronics;
- Radio and Television;
- Agricultural Mechanisation;
- Computers;
- Telephone;
- Air Conditioning and Refrigeration;
- Highways;
- Spacecraft;
- Internet;
- Imaging;
- Household Appliances;
- Health Technologies;
- Petroleum and Petrochemical Technologies;
- Laser and Fiber Optics;
- Nuclear Technologies; and
- High-performance Materials.

CONTACT DETAILS:

If you are interested in obtaining a copy of the book, contact du Toit on 083 666 6855 or du.toit.grobler@gmail.com

January

COMPILED BY | JANE BUISSON-STREET
SMSAIEE | PMIITPSA

January is the first month of the year in the Julian and Gregorian calendars and one of seven months with the length of 31 days. The first day of the month is known as New Year's Day – the most celebrated holiday in the world.

1 January

44BC The Julian Calendar is introduced by Julius Caesar, the founder of the Roman Empire.

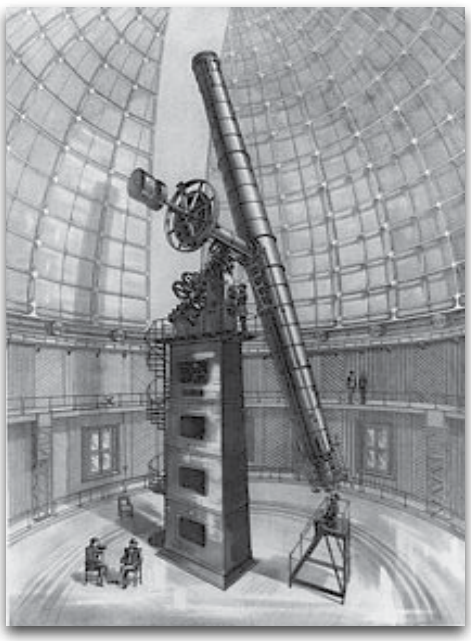
1772 The first traveller's cheques, which can be used in 90 European cities, go on sale in London, England, Great Britain.

1901 The Commonwealth of Australia is established.

1961 The British farthing is no longer accepted as legal tender.

1985 The Internet's Domain Name System (DNS) is created.

1999 The Euro becomes the official currency of 11 European countries.



3 January

1888 The refracting telescope at the Lick Observatory, measuring 91 cm in diameter, is used for the first time. It was the largest telescope in the world at the time.

1924 Howard Carter, British archaeologist, discovered a dazzling discovery in Egypt's Valley of Kings – Tutankhamen's tomb. The contents included a solid gold coffin, a gold mask, jewellery and other artefacts. Tutankhamen was an 18th dynasty pharaoh who died over 3350 years ago.

1961 The millionth Morris Minor car rolls off the assembly line in Britain.

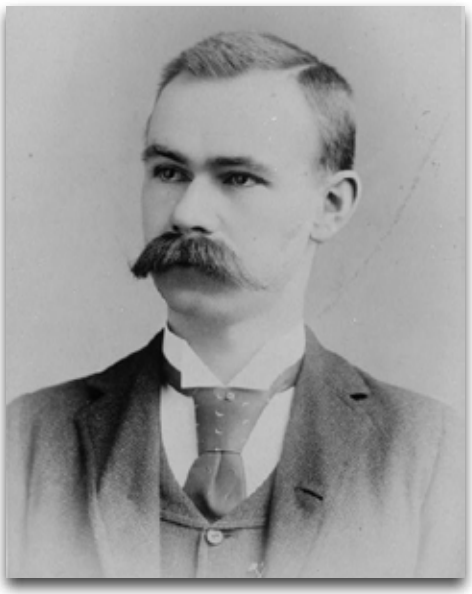
2000 The last original weekday Peanuts comic strip is published.

5 January

1896 German physicist Wilhelm Roentgen today demonstrated what he calls the X-ray. This is a form of high-energy radiation that allows him to see through solid objects. It is thought that this technique may be useful in medicine. Roentgen discovered this quite by accident.

1956 Elvis Presley records "Heartbreak Hotel"

1971 England plays Australia in the first ever one-day cricket match in Melbourne.



8 January

1889 Herman Hollerith is issued US patent #395,791 for the 'Art of Applying Statistics' - his punched card calculator, the first computer.

1958 *"How can you govern a country which produces 265 different kinds of cheese?"*, General Charles de Gaulle, on his appointment as French premier.

9 January

1951 Life After Tomorrow, the first film to receive an 'X' rating in Britain, opens in London.

11 January

1963 The first discotheque, Whiskey-Au-Go-Go, opens in Los Angeles.

1974 The first surviving sextuplets are born to Mrs Sue Rosenkowitz of Cape Town, South Africa.

13 January

1897 Mr and Mrs Bradley Martin, high-flyers in the "400", New York's gilt-edged society set, were making a bid for the party of the year. The ballroom of the Waldorf Astoria was converted into a Palace of Versailles replica with no expense spared. The next day's newspapers said that in the face of the nation's worst ever depression, the party was a disgrace. The Martins fled public outrage and have just arrived in England leaving only "398" top people in New York.

1957 Elvis Presley records the hit "All Shook Up" in a Hollywood studio.

17 January

1852 Britain recognized the independence of Transvaal in the Sand River Convention.

1876 Etta Morgan plays the then little known saxophone at New York City's Olympic Theatre, bringing it to attention in the United States.

19 January

1903 Sports promoter and journalist Henri Desgrange today announced plans to hold a gruelling bicycle race across France this summer. It will be called the Tour de France and will cover about 4000 – 4800 km of roads and mountain passes throughout the country and into parts of its five neighbours. The new race reflects the recent increase in competitive cycling championships.

20 January

1882 A draper's shop in Newcastle-upon-Tyne becomes the first shop in the world to be lit by an electric light.

1936 Britain is today mourning the death of King George V after his 26-year reign. He was the grandson of Queen Victoria, was responsible for changing the name of the Royal Family from Saxe-Coburg-Gotha to Windsor during the Great War in order to emphasise the distance from his German cousins. He also began the tradition of the monarch's Christmas radio broadcasts.

22 January

1879 Zulus massacre British forces in Isandlwana.

23 January

1989 "Geniuses don't die, I'm going to live forever," the Spanish surrealist painter Salvador Dali is on record as saying. Nevertheless he died today at his Spanish castle in Figueras.

24 January

1935 Canned beer is sold for the first time in Richmond, Virginia.

2001 Five million Hindus attend the Maha Kumbh Mela at Allahabad, India, in the largest ever gathering of humans. The crowds flocked to bathe in the River Ganga at dawn.

26 January

1905 A magnificent diamond has been discovered in South Africa, the largest rough stone ever found. Weighing in at nearly 3106 carats (621,2g), the Cullinan diamond is also of high-quality.

30 January

1961 The contraceptive pill goes on sale in the UK, although it is not available on the National Health Service.

31 January

1956 A.A. Milne, the creator of Winnie-the-Pooh, dies. wn

The Art of Communication

A certain lecturer asked his third year engineering class what they considered to be the most important aspect of their training so far and the one they thought would be most useful in the course of their future professional life.

BY | "ISCOR APPIE" GEOFF CARTER **|** PR TECH ENG **|** BSC HNDT **|** MSAIEE

The answers come from the length and breadth of the engineering curriculum.

Most of the students wishing to curry favour with the lecturer, who was known to embrace the thoughts of Leibnitz, Newton and a few other names I had scant knowledge of, gleefully and sycophantically murmured the word, "mathematics".

The lecturer hung his head and was a broken man. The evidence of his and his colleagues' failure to educate these bright and enquiring minds slouched in front of him….a beer sodden, hairy, glutinous mess oozed into the seats of the tiered lecture hall.

Visions of exploding electrical equipment, falling bridges and crashing aircraft flashed in front of his eyes. Heaven help the world when this lot was let loose on humanity…

He took a deep breath and counting the days to pension, proceeded to dissect their family trees one by one. *"Compost!!"*, he screeched. "*Your family trees aren't worth compost!!*"

NO! He exclaimed, with emphasis on the exclamation mark…., *"none of that is any use unless you can tell other people in clear and concise terms what you are thinking.*

And furthermore, you should be able to defend your viewpoint convincingly while standing in front of a group of your colleagues".

The stunned silence wafting over from the floor provided ample evidence to suggest his theory may hold merit.

What are the elements that will contribute to making one professional appear to be more successful than another? I certainly can't confess to knowing all of them. But I have identified one of them.

It is simply the ability to communicate well.

All the successful engineers I have met are excellent communicators. They take a great deal of care to explain what it is they are trying to ensure you understand. They assume you know nothing and are very patient in filling in the gaps.

This is particularly so when assigning a task to a junior member of the profession. A manager who does not explain in detail what he requires is setting his man up for failure.

A good engineer has the ability to capture an audience and hold their attention. Let's face it; some of the waffle discussed in engineering meetings is really mind-blowingly boring. Yet, some guys have the ability to get the message

across in short sharp verbal deliveries. When one reads the documents they produce, their ability to get to the point by way of the shortest possible linguistic route is richly apparent.

So! How many of you took your English/Afrikaans/Zulu teacher seriously at school?

None of you I'll bet! You were all too busy throwing Lithium into the science lab basins.

When I left school, I estimate I had a vocabulary of approximately 400 words. Eighty of them were the brand names of popular beers and twelve the names of past girlfriends. After national service, I had a vocabulary of about 500. I learned a lot of new four letter epithets, many of them describing my dubious heritage. Not much of a communications ability to begin a career in engineering. I managed to waffle and whinge my way through some verbal disasters early on in my career. As I recall, promotions and bonuses were scarce in those days.

Then I discovered TOASTMASTERS.

If there is anybody out there who needs assistance in learning the art of public speaking, then these are the guys for the job. They have a brilliant program for teaching you to speak with confidence. You will be trained to deliver prepared material as well as impromptu speeches, like a politician.

What did I learn from these guys which helped me in my ability to communicate?

- Organise your thoughts beforehand.
- Memorise the key points of the theme.
- Explain your idea to the dog. (My Jack Russell has passed MAT III ….twice!)
- Tell a story, introduction, middle and end.
- Pause for breath often. Use the time to re-organise your thoughts.
- Allow the audience to participate. Make eye contact.
- Use an interrogative process to judge if the audience understands what you want them to. Allow them to ask questions.
- Join your local chapter of TOASTMASTERS.
- Read good magazines such as Time, the Economist, Engineering News, etc.
- Join your local chapter of TOASTMASTERS.

And finally, did I mention?……Join your local chapter of TOASTMASTERS.

This will give your public persona a much needed boost.

CPD

TRAINING COURSES

FEBRUARY

Photovoltaic Solar Systems
Date: 19-20 Feb. 2014
Venue: SAIEE House

LV Protection
Date: 26-27 Feb. 2014
Venue: Corporate Conference Centre
Dowerglen, Edenvale

MARCH

Electric Arc Flash Safety
Date: 13 March 2014
Venue: Corporate Conference Centre
Dowerglen, Edenvale

Fundamentals of Power System Calculations
Date: 18-19 March 2014
Venue: Corporate Conference Centre
Dowerglen, Edenvale

Design of Economical Earthing System for Utility Electrical Installations
Date: 26-27 March 2014
Venue: SAIEE House

Should you require further information on any of these listed course and would like registration forms please contact:
Roberto Benites 011 487 9042 or email roberto@saiee.org.za

Technology: I'm not a nerd!

How do I know this? Because nerds love technology, nerds love computers, nerds love gadgets (Yes, engineers are nerds).

BY I ANGELA PRICE

On the other hand, am a technophobe. I have what I believe, is an understandable fear of technology and I don't think that I stand alone in this.

Yoda once said *"Fear leads to anger, anger leads to hate, hate to ….suffering"**.

Psychologists advise that part of overcoming your fear/phobia is being able to understand what is causing it. I cannot say for certain where my fear stems from, but for the most part I think it is caused by:

- the overwhelming volume of new technology that is continuously being produced;
- the amount of time required to familiarise oneself with all the new technology; and
- the complexity of the technology.

The sheer volume and diversity of technology that is made available to us, and the speed with which it is being produced, overwhelms me. Just when you think you have acquired the latest and greatest smartphone or tablet, you discover that a newer/faster/thinner model has just been released, and your prized purchase has become 'old' within technological nano seconds.

The amount of time needed to learn how to operate much of this technology, also intimidates me - to the point of inaction. I once spent the whole of a 4-hour long road trip trying to read the help functionality on my Blackberry. By the end of the trip, I was so lost in the labyrinth of short cut keys and media possibilities, that the only way 'out' was to put the phone away and forget about the whole functionality foray. And all I had to show for my hours of effort was that I now had my psychologist on speed dial!

Interestingly, physical user manuals are also become archaic, with most gadgets now equipped with online help/ user guides and a 'play with it' approach to finding out how the unit functions. In a day and age when one has less and less time available, I find myself struggling to find the time to fritter away playing on gadgets. But possibly it is a sacrifice one has to make with a 'no pain no gain' mentality. In theory, the time one invests in learning the functionality, should be saved once you are using your device to the max. Isn't it ironic that one can accomplish just about anything with all this technology at our fingertips - given a little time. But time is the one thing we all lack.

There are many of us who have limited understanding of the foundations which all this technology is built upon (Engineers not included). I myself, find it difficult to understand the complexities of the new and emerging technologies. If for example, ones PC skills and capabilities where limited a few years ago, it becomes harder and harder to grasp the newer developments in the field. The chasm widens, the leap (of understanding) seems too large to bridge….and the fear worsens.

However, whist working through my technophobia issues on the shrinks couch, I discovered I had yet another fear/ phobia…FOMO. Turns out, this Fear Of Missing Out is even greater than my fear of technology!

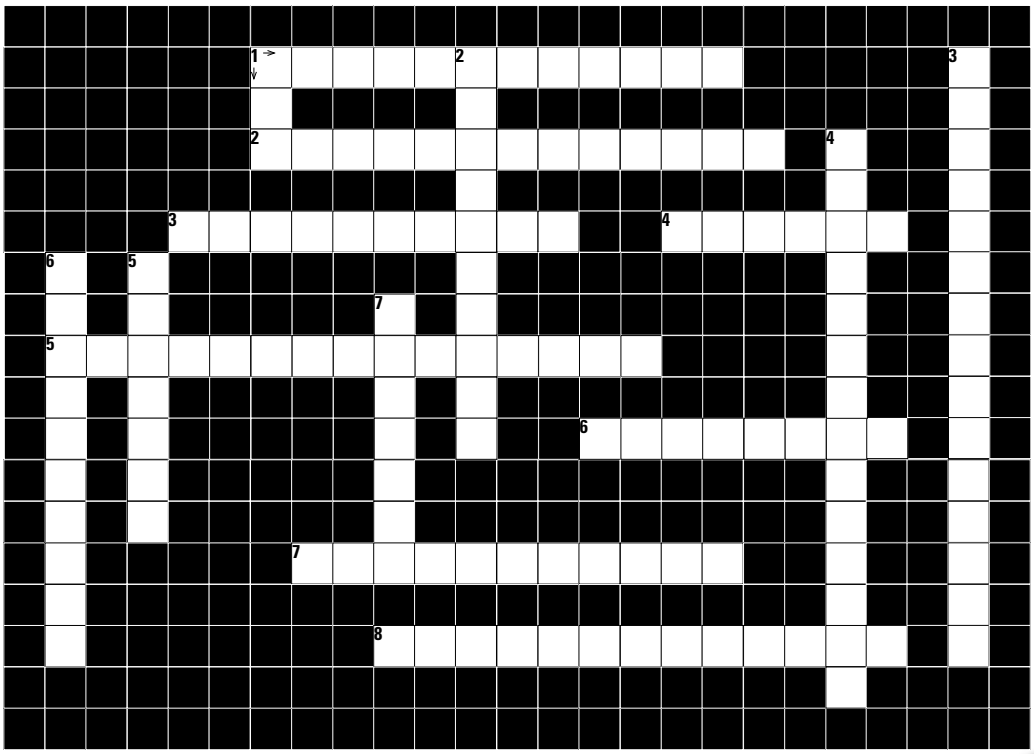
So fortunately for Apple, Samsung and the likes, I will undoubtedly be acquiring their latest technological offerings in the near future – with much fear and trepidation.

…. just last week, the phone would not function properly, I feared I would never manage to get it right in time, I got angry, hating the phone in that instant, I threw it against the wall…said phone broke and I suffered the resulting inconvenience and expense. Yoda was right.

Have some fun and stand a chance to win R1000. Complete the January issue crossword puzzle and send it with your name, surname and contact details to: *Managing Editor, January 2014 Crossword Puzzle, P.O. Box 751253, Gardenview, 2047* or email it to *minx@saiee.org.za.* The completed crossword puzzle should reach us by no later than **31 January 2014**. The winner of R1000 will be announced in the March 2014 issue of the **watt**now magazine.

R1000 win

BERGMAN FISHER ASSOCIATES, DESIGNERS OF A SAFER GREENER ENERGY EFFICIENT FUTURE, ARE THE PROUD SPONSOR OF OUR CROSSWORD PUZZLE.



ACROSS

1. Who published *A Guide For The Perplexed* in 1977 as a critique of materialist scientism and as an exploration of the nature and organization of knowledge? (1,1,10)
2. See 2 down.
3. _____ technologies are where a new method replaces the previous technology and make it redundant. (10)
4. Name the car from the Hiriko folding car project (6)
5. A branch of critical theory devoted to the study of technological change. (15)
6. Who believed that science and democracy were the right and left hands of what he called the move from the realm of necessity to the realm of freedom? (4,4)
7. Which inventor is among techno-utopians who believe that emerging and converging technologies could and will eliminate poverty and abolish suffering? (3,8)
8. See 4 down.

DOWN

1. Electrical Engineering Technology (abbr.)
2. This refers to any ideology based on the belief that advances in science and technology will eventually bring about a utopia. (13,10)
3. What is considered to be the number 1 engineering achievement of the 20th century? (15)
4. Name two aspects where modern technology has simplified lives. (14, 13)
5. Name South Africa's first cube satellite. (7)
6. Futures studies. (10)
7. Which computer scientist has identified clusters of technologies that he consider critical to humanity's future? (4, 3)

October issue winner:
Jacques Le Roux | Pretoria

October issue answers:

ACROSS
1 Photometry **2** CFL
3 Light Emitting Diode Lamp
4 Foot Candle **5** Abraham **6** Torchiere
7 Fluorescent **8** SI **9** Lumens

DOWN
1 Thermodynamics **2** Filament
3 Lux **4** Gesner
5 Dosimeter **6** Beacon **7** Balast
8 Kelvin **9** Neon

Terms and conditions: 1. Only one entry per person. 2. Winners will be notified via email. 3. Incorrect information will automatically disqualify the entrant. 4. Anybody may take part except the office staff of the SAIEE, their family members and members of the Publications Committee. 5. **watt**now magazine and the SAIEE cannot take any responsibility for lost entry forms or any damage, losses or injuries related to the draw of the prize. 6. Closing date for entry is 31 January 2014. 7. The winner will be announced in the March 2014 issue of the **watt**now magazine. 8. The Managing Editor's decision is final and no correspondence will be entered into.

Calendar of events

If you want to see your function or event listed here, please send the details to Minx Avrabos at minx@saiee.org.za

JANUARY 2014

12-16	ICILLS 2014 (Impact Loading)	One & Only Resort, Cape Town	www.icills2014.org

FEBRUARY 2014

18-20	Africa Energy Indaba	Sandton Convention Centre, Johannesburg	www.africaenergyindaba.com
25-27	2014 8th IEEE CIPS	Nuremberg , Germany	www.conference.vde.com

MARCH 2014

4-5	Renewable Energy Forum South Africa	Norton Rose Fulbright, Sandton, Johannesburg	www.refsaconference.com
11-12	Power and Electricity World Africa	Sandton Convention Centre, Johannesburg	www.terrapinn.com
11-12	Shale Gas World Africa	Sandton Convention Centre, Johannesburg	www.terrapinn.com
16-20	APEC 2014	Fort Worth TX , USA	www.apec-conf.org.com
17-19	PowerGen Africa 2014	Cape Town Convention Centre, Cape Town	www.powergenafrica.com
17-19	Distributech Africa 2014	Cape Town Convention Centre, Cape Town	www.distributechafrica.com
27	SAIEE AGM	Military Museum, Johannesburg	geyerg@saiee.org.za

APRIL 2014

8-9	CSP Today South Africa 2014	Southern Sun Cape Sun Hotel, Cape Town	www.csptoday.com
8-10	2014 IET 7th PEMD	Manchester, United Kingdom	www.theiet.org.com

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