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- Be suspicious of **prices** lower than for other, similar products/services.
- Be suspicious of **lack of information** on or with the product packaging.
- Ask the supplier for **references** to other users – and contact them.
- When dealing with an electrical contractor, ask for proof of registration and about its membership of the **ECA** (Electrical Contractors Association). Call the ECA in your region to check credentials.
- Be critical of a suspect installation or a **Certificate of Compliance (COC)** that is issued too easily.
- Ask the supplier to prove **compliance with regulations**.
- Look for **certification marks** such as **SABS, VDE and UL**. (Note that the SABS mark is not necessarily a substitute for the LOA).
- Beware of **fraudulent use** of well-known certification emblems, such as the SABS mark.
- A “**CE**” mark is not proof of independent testing and not necessarily proof of conformity.

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GENERAL REGULARS



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It's March, the leaves are changing, the day has a chill in the air, which is bringing us the winter. Where autumn is a lovely time of the year for me, it also brings with it a very sad-dened heart.

One of my dearest friends, technical editor, comrade and 'staatmaker', Derek Woodburn, passed away suddenly on the 13th of March. His shoes will never be filled with the diligent work he did with Jane and me. He will surely be missed. Read the Tribute to Derek on page 14.

This issue focusses on Digital Technologies, and the first feature article can be found on page 22, "Unlocking the Power of Digital". South Africa's vibrant digital economy makes it stand out amongst its emerging market peers, and we have now the opportunity to use ex-pertise to reinvent the industrial sector.

Many people ask the question: "What is Blockchain Technology?" The blockchain is undoubtedly an ingenious invention. Read what it's all about on page 32.

After decades of unbridled enthusiasm, the public might be losing trust in digital technology because you cannot always believe what you read on the internet. Read more on page 42.

This issue sports another interesting article from the pen of Dudley Basson, "Quantum Materials". Read it on page 50.

Herewith the March issue, enjoy the read.



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JACOB MACHINJIKE
2017/8 SAIEE PRESIDENT

The shift from mechanical and analogue electronic technology to digital electronics has been a growing trend since the 1960s leading on to the 1980s, with the adoption and increase of digital computers, digital record keeping and all the myriad of gadgets, systems and devices we see around us today.

This digital revolution is the mass production and widespread use of digital logic circuits, and its derived technologies, including the computer, digital cellular phone, and the Internet.

The digital revolution has contributed to the process of creative disruptions that “modernizes” the modus operandi of society; and include the economic, business, academic, social, cultural, and political spheres, amongst others. Disruptive technologies can prove to be advantageous to society with the provision of quality products and services, in ways that are better, cheaper and faster. Blockchain technology, for instance, will significantly change the way systems and processes work, as well as how we keep records and transactions on a varied range of issues. Crypto-currencies, like bitcoin, operate on blockchain technology platforms. Bitcoin mining and the trading in the crypto and alternative currencies are proving to be a headache for governments and is fierce competition for Central banks and fiat currencies.

The Electrical Engineering as well as Information and Communications Technology practitioners have enabled digital technologies to make significant contributions that benefit society by providing solutions, and will continue to do so.

It is electrifying to think of digital, as of signals or data, expressed as series of the digits 0 and 1, typically represented by values of a physical quantity such as voltage or magnetic polarization. Electrical engineering deals with the study of, and application of, electricity, electronics and electromagnetism, and related aspects and

to study this discipline requires subjects like mathematics, science and physics.

Prediction mathematics is a combination of Schrödinger Wave Mechanics, Poisson Mean Arrival Rate Equation and Binomial Distribution Equation. I have observed that this provides part of the engineering and science behind crypto-currencies trading. All this can be distilled from mathematical equations and crypto-currency software mechanisms into simple understandable prediction mechanics that any interested person can use.

There lies an advantage to those having an electrical engineering background and that is where one could get excited about making money in a scientific way. When the price of a crypto-currency is increased by electrical impulses arising from purchase of coins versus the supply of the coin. As investors arrive on the scene it triggers upward movement. The mean rate of arrival or trades is given by Poisson equation. So, one buys low value crypto at the bottom, ride to the top and disembark or sell when the crypto gets tired.

The Blockchain Revolution has enabled optimism in crypto currencies being used as a means of exchange in buying and selling, as well as in wealth creation through short-term crypto currency trading and bitcoin mining.

One needs to think hard when considering holding crypto currencies as an investment or a store of value.

J Machinjike | SAIEE President 2017
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Cummins Southern Africa announces confidence in business environment



The Cummins Team

Cummins Southern Africa is pleased to announce a positive outlook for 2018 in the Southern African region. Indicators are consolidating for the company's key markets where an increase in mining activity, equipment rebuilds, the appreciation of the oil price and the progress of major infrastructure and power projects bear testament to a favourable business environment.

Commenting at a media junket, Mr Thierry Pimi, Managing Director of Cummins Southern Africa said: *"Despite difficult market conditions last year, Cummins performed very well by exceeding our sales forecasts and increasing our investments in the region. We are totally committed to the African continent and will continue to grow our business and innovate new solutions for our customers. We have full confidence in the market as current political developments drive predominantly pro-business and pro-regulatory reforms in South Africa, Zimbabwe and Angola. We anticipate an*

improved relationship between the business community and the new government in the country which we are confident will lead to a swifter resolution of the Mining charter dispute. We look forward to seeing this leading to increased investments in the country."

Cummins Southern Africa continues to invest significantly in capabilities and developing people to provide world class aftermarket support to customers in the region. The company is on track to commissioning its new Johannesburg flagship facility at Waterfall City in October 2018.

This new facility will also serve as the launch pad for brand reinforcement to attract the best talent in the region. Moreover, "Several strategic initiatives are currently being set in motion. With the best people, we will continue to deliver world class service in the region and honour our promise to our customers. In

2018 we will more aggressively drive our transformation agenda in South Africa with some key milestones set for completion by the end of Q2," Pimi added.

Corporate Responsibility rates highly on the Cummins agenda, and the company has launched many socially responsible programs that benefit local communities in which they operate. The company's 1st TEC Program (Technical Education for Communities), in partnership with Komatsu SA, will be launched in April 2018 at the Sedibeng Technical Vocational Education and Training College.

The regional channel strategy execution will continue into 2018 and with the recent integration of the Angolan operations, Cummins Southern Africa will now cover the entire Southern African Development Community (SADC). Plans are also in place to boost the company's presence in Zimbabwe, Madagascar and Mauritius with increased human capital, improved capability and the availability of parts and whole goods on the ground to more effectively support customers.

With a strong brand built up over almost a decade, Cummins Southern Africa has a powerful presence in the region in the areas of power generation, mining, automotive, marine and aftermarket support.

The company announced new high tech innovative solutions from various divisions within Cummins Southern Africa, ensuring the highest levels of service are delivered to its customers.

Enabling IoT to Change Lives Across Africa

Growth of solar as a central energy source across East Africa has new life

The Internet of Things (IoT) is impacting the lives of millions around the world – but none more so than those in Africa. SolarNow, a social business passionate about transforming lives by providing high quality solar energy, appliances and financing solutions in East Africa, has turned to IoT, while also integrating M2M cellular connectivity and AWS Cloud within its solutions to provide more and better services to SolarNow customers.

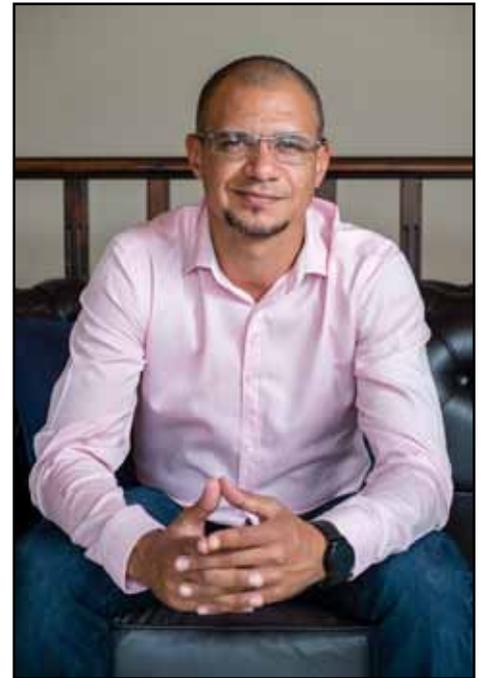
While the time, costs and risks involved in setting up IoT deployments can appear to be daunting, SolarNow turned to IoT M2M connectivity specialist Eseye. The market leader offered a highly secure and reliable global cellular network data through the AnyNet Secure™ SIM, with seamless integration onto the AWS Cloud.

Jeremy Potgieter, SADC regional head, Eseye says that SolarNow's requirement was to enhance access to and use of device data: *"They wanted better oversight of remote equipment and to be able to communicate with clients, for example when payments are due or if there is an issue with their device."*

The SIM's enhanced features also enable SolarNow to remotely and securely activate, provision, authenticate and certify deployed devices over-the-air, in up to 190 countries. Integration with AWS Cloud Services, further simplifies project set up and deployment by reducing the need for investment in specialist inhouse infrastructure and development resources. By adding AWS' software tools and cloud, SolarNow establishes the means to simply and quickly analyse data and to scale instantly and securely, on demand.

Solar as an energy source is becoming increasingly vital and viable to off-grid populations in the East African region; in part to reduce the widespread use of polluting and dangerous kerosene lamps, but also to harness the significant economic, social and health benefits reliable power sources provide.

SolarNow addresses the unmet need for sustainable, quality solar energy in the region through the provision of solar powered equipment, appliances and services to remote or off-grid home, farm,



Jeremy Potgieter
SADC Regional Head, Eseye

school, health centre and business locations. To make a deployment achievable, the company offers affordable and flexible credit with every solution, a key feature in widening access to solar energy in the African market.

Humidity Generator calibrates probes with accredited 1,0% RH system accuracy

Comtest is offering the latest Fluke 5128A RHapid-Cal Humidity Generator, a portable, versatile humidity generator for calibrating a large workload of probes and loggers in the field or laboratory.

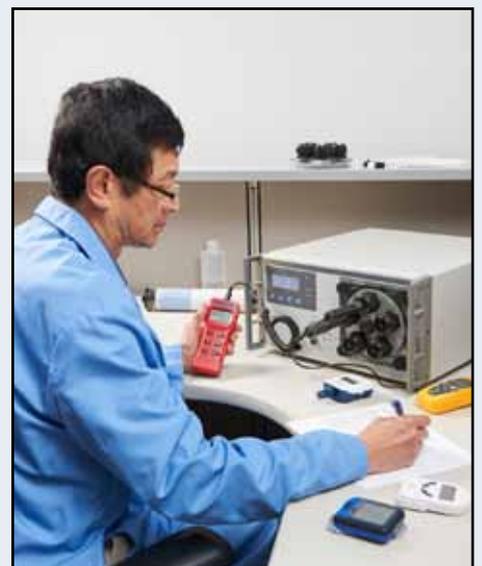
The 5128A is ideal for corporate and independent calibration labs where humidity measurement is critical to prevent spoilage of products, including pharmaceuticals, medical devices, semiconductors, chemicals, and food production.

The 5128A is lightweight and compact so technicians can easily take it to the field for

thorough, reliable multi-point calibration of humidity probes and loggers. In the lab, the 5128A reduces calibration time by at least 33 percent compared to traditional two-pressure humidity generators, which are slower to respond to humidity and temperature set point changes.

The 5128A RHapid-Cal comes standard with an ISO 17025 accredited system calibration and is backed by Fluke Calibration's world-class metrology and support.

For more info, visit www.comtest.co.za



WATTSUP



ELPA geared to empower lightning specialists

From designers through to installers and inspectors of Lightning Protection Systems (LPSes), as well as electricians and electrical engineers, the Earthing and Lightning Protection Association (ELPA) is ensuring that it implements all programmes necessary in its quest to become South Africa's recognised National Professional Body for earthing and lightning protection. ELPA national director Trevor Manas clarifies, "ELPA aims to assist with providing industry accreditations, certification, benchmarks for quality of design and installation, as well as information and education on lightning safety." Having been officially established in June 2017, after two years of hard work by lightning protection industry experts from around the country, Manas says the umbrella body has already notched up a number of achievements.

"During 2017, we held two successful sets of certification exams for lightning protection installers," Manas outlines. "In January 2018, we followed this up with the introduction of accreditations for electricians who carry out surge protection installations. This new programme covers the proper selection, coordination and installation of surge protection devices (SPDs) to power supply systems, and we believe that electricians will gain extremely valuable guidance in this part of their scope of works. At the same time, we launched our first designers' accreditations, noting that the actual science of lightning protection really comes together in the lightning protection design. The designers' course will follow a modular process: there are five parts to each module, and each module will take a month to complete."

More to come through the COC programme. Other certification exams will follow in during 2018, and are linked to the launch of the ELPA Certificates of Compliance (COC) programme in late 2017.

Manas explains, "The COC programme is aimed at ELPA-accredited designers, installers and inspectors of LPSes. It entails the keeping of a register of designers and installers, as well as the inspectorate whose members check the work being done by the installers. To this end, another round of lightning protection installation certification exams took place in January, marking the third such set of exams since August 2017."

NitraLife nitrogen generators: In for the 'long haul' with Jabula Plant Hire



From left: Twayne Stewart, NitraLife Operations Manager and Danie Els, Maintenance Manager at Jabula Plant Hire Leandra.

Of all the components on a commercial vehicle, tyres are some of the more critical items, as their reliability affects not only the vehicle's performance but its safety as well. National heavy duty transporter Jabula Plant Hire is keenly aware of this and, for

this reason, takes proactive steps to make sure that tyre life and performance are maximised.

Founded in 1995, Jabula Plant Hire has grown to be one of South Africa's top five earthmoving and mining commodity logistics companies, on the strength of its innovative solutions and superior service. While a large part of its operations are in contract mining services, the company also helps keep South Africa's lights on by transporting coal from the mines to the various power stations they supply.

"In this business, reliability is the key. To ensure unfailing reliability, we purchase new vehicles only and our trucks are replaced every 3 years. Similarly, when it comes to tyres, we insist that all of our 153 heavy transport vehicles and 70 earth-moving machines have their tyres inflated with nitrogen," Els explains.

"This is not only prevents failures but, as tyres are a very significant expense for Jabula, the extended tyre life we get from nitrogen

Schneider Electric announces winners



Schneider Electric is proud to announce the Gauteng Win-A-Trailer Electrical Contractors competition winners. The winners are: Fausto Vietri (Noby's Electrical), Jaco van der Westhuizen (GB Electrical Contractors), Riaan Kriel (TMK Electrical) and Frik Jacobs (Lesedi Corporate Services).

The Partner Retail Business Unit launched the Win-A-Trailer competition last year in July. This was a four-month competition and digital campaign from 01 July to 31 November 2017. South Africa's Electrical contractors had to purchase Schneider Electric wiring devices (S2000, S3000 or ZENcelo) to the value of R500, which granted them one entry into the Win-A-Trailer competition.

Three-Year Energy IoT Deal to Maximize Productivity

Invenergy, North America's largest independent, privately-held renewable energy company, and NarrativeWave, announced a three-year agreement. Invenergy will use NarrativeWave's software to optimize its fleet of wind turbines and other renewable energy assets.

The announcement follows a successful 60-day pilot, where Invenergy proved out two use cases for their operations. The first use case focused on Reducing Lost Production. The second use case focused on Reducing Unscheduled Downtime, accomplished by empowering mechanical, electrical, and turbine performance subject matter experts (SMEs) to rapidly build analytic models and deploy them across a fleet of turbines without the need for data scientists. Through these pilots, operators in the 24/7 Invenergy Control Center (ICC) used NarrativeWave to fully automate time-consuming manual processes and accelerate return-to-service times on wind turbines, in some cases by more than 50%.

"NarrativeWave is one of the first solutions available focused on empowering domain experts," said Johnny Dobbins, Director of Client Engineering at NarrativeWave. *"Our industry-leading partners are focused on closing the gap between their data and SMEs, while reducing data science and engineering costs associated with delivering actionable insights."*

inflation results in significant financial savings," he adds.

Jabula has been filling its transportation and earth-moving vehicles with nitrogen from nitrogen generator supplier NitraLife since 2008. Jabula purchased its first NitraLife nitrogen generator in 2008, which was installed at the company's Rietspruit site. Eight years later, in 2016, the company opened its Leandra depot and almost immediately installed another NitraLife generator at this site.

Nitrogen tyre inflation brings many advantages says Els, explaining that it prevents premature tyre failures, eliminating tyre bursts and tread separation among many other things.

NitraLife's Operations Manager Twayne Stewart explains that since its founding in 1996, NitraLife has established that transportation sector companies can save between 5 – 30 % on their tyre costs - depending on fleet and load size, and distances travelled. *"Nitrogen escapes through tyre walls four times more slowly than oxygen and 117 times more slowly than water vapour. For this reason, nitrogen-inflated tyres hold consistent pressure for far longer,"* Stewart explains.

"If tyres are under-inflated, they tend to flex and overheat - the heat build-up being a major cause of premature tyre failures," he observes, adding that this becomes even more important if the tyres are under a heavy load and have to cover long distances.

Air contains oxygen and water vapour, two compounds which – over time – degrade tyre rubber. Once air is pumped into a tyre, water vapour is concentrated inside the casing and along with the action of oxygen, degrades the rubber and causes the steel within the tyre to corrode. This reduces the tyre's ability to hold pressure and also leads to early casing failures. By replacing these compounds with high-purity nitrogen, tyre casings are preserved and can be retreaded many more times than their air-filled counterparts. Also, stronger, longer-lasting casings mean a minimal rate of premature tyre failures.

"In so doing, we are delighted to contribute to Jabula's long-term success, and we are 'in it for the long haul,'" Sowry concludes.

WATTSUP

Introducing Land Rover Explore, The Outdoor Phone

Land Rover and Bullitt Group have unveiled details of the Land Rover Explore Outdoor Phone.

At the heart of the Land Rover Explore is a powerful 4000mAh battery that gives two days of typical use, or a full day of activities, with constant GPS Navigation mapping activated on the 5" HD display. Battery life can also be doubled by adding the included Adventure Pack while on the go. Once added, it can replace the need for a separate GPS device with its GPS patch antenna that improves the reliability and accuracy of the GPS. It also adds additional 3600 mAh of battery power and premium topographic mapping with Skyline augmented reality, courtesy of ViewRanger.

Other hardware packs available include a large 4370mAh additional battery and a universal bike mount, all designed to enhance any adventure by enabling owners to go further, and stay out for longer.

The Land Rover Explore withstands everyday use outdoors with exceptional durability. It is drop tested to 1.8 metres with a factory fitted screen protector, it can survive underwater, including salt water, complying to IP68 rating and can cope with extreme temperatures, thermal shock, humidity and vibration exposure. This level of protection ensures the device can survive heavy downpours or a muddy trail and will continue to work, keeping users connected at all times.

Designed in close collaboration with Land Rover, the smartphone takes subtle design



cues from the unbeatably capable and versatile Land Rover Discovery. Taking inspiration from the front grille design through to the headlamp architecture and even the knurled finish of the interior dials, it elegantly reflects the essence of the Land Rover brand. It's a durable smartphone in a stylish design that is suitable for the office or enjoying the great outdoors.

The home screen features a customisable Outdoor Dashboard for instant access to weather condition information and sensor data from the device. It can be set up to show the details most relevant to any activity at a glance. Separately, the Explore Hub is a curated app portal, with a content catalogue relevant to many outdoor activities, as well as the Land Rover InControl apps. Plus, small features like a handy SOS flashlight and a Night red filter mode to reduce screen glare, help to ensure the Land Rover Explore is perfect for everyone with a passion for the outdoors.

Notable features also include a bright 5-inch full HD screen that's optimised for sunlight legibility, while the touchscreen can be controlled with wet fingers or while

wearing gloves. Improved connectivity options are provided by a dual SIM feature, giving users the ability to connect to two networks.

Joe Sinclair, Director of Branded Goods and Licensing for Jaguar Land Rover said: *"We are excited to be collaborating with Bullitt Group to create the smartphone that we'd all like to own. A perfect combination of design and functionality that embodies the Land Rover DNA and enables customers to be outdoors for longer, with the confidence to go further."*

Peter Stephens, CEO of Bullitt Group, global mobile licensee for Land Rover commented: *"Building on our leadership in the rugged mobile market, we see the growing customer dissatisfaction with the fragility of their mobile phone and the poor battery life in particular, preventing them from using their mobile for key parts of their day to day life. The Land Rover Explore embodies everything we know to create a device perfectly suited to any outdoor activity, whilst retaining a sleek design."*

The phone will be available for pre-order in South Africa from April 2018.

Actom Turbo Machines Remanufactures Critical Components In Fast Track Contract

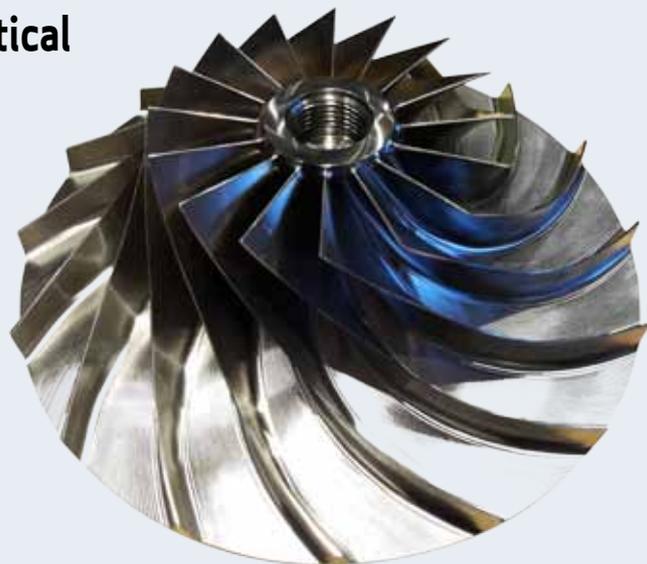
ACTOM Turbo Machines, a division of ACTOM, recently manufactured high precision impellers and pinions for a large 190 kg/h 20 bar pressure integrally-gear multi-stage centrifugal compressor to replace these components after they had been destroyed when the compressor failed.

When the Vanderbijlpark plant of Air Products South Africa, leading producers and suppliers of gas and chemical products to industry, awarded the refurbishment contract to Sasolburg-based ACTOM Turbo Machines late last year, it stipulated a period of three months for completion of the project so that the compressor could resume operation as quickly as possible.

At the same time the refurbishment of the 2 500 kW 11 kV 2 pole AC induction motor that drives the compressor was assigned to Marthinusen & Coutts, ACTOM Turbo Machines' sister business unit in Johannesburg.

The compressor is used for direct supply of nitrogen by pipeline to two of Air Products Vanderbijlpark's largest customers in the Vaal Triangle.

"Three months is an extremely tight timeframe as it is about a third of the time that would normally be allocated for such a complex task, especially taking into account that we had to manufacture the replacement impellers and pinions by a reverse-engineering process, which was necessitated by the short turnaround time as set," Chris Bezuidenhout, ACTOM Turbo Machines' managing director, says.



"In addition, we had to ensure that the tolerances between the various components were strictly adhered to, these being especially critical in this instance as the compressor is a four-stage high-speed unit operating at speeds of between just below 20 000 r.p.m. and in excess of 33 000 r.p.m." Both the first- and second-stage impellers and pinions had to be replaced by newly manufactured units. *"We manufactured all these to a tolerance with a margin of error of 0,02 mm, which is well within the norm to ensure extra protection against any risk of damage during operation,"* Bezuidenhout points out.

All the rotating components, comprising the gear set, impellers and pinions, were balanced in accordance with the international ISO 1940 specification. The compressor was then assembled and delivered to site where together with the motor, as modified by Marthinusen & Coutts, it was installed by ACTOM Turbo Machines technicians in Air Products' plant.



Next Generation Wifi Fibre Optic Connector Inspection System

COMTEST's latest offering from AFL is the aeRos[®] connected FOCIS WiFi2, the next generation fibre optic connector inspection system that uses an Android or iOS wireless connection for live image video streaming, auto-focus and more. The FOCIS WiFi2 probe is ergonomic and lightweight, fitting perfectly and balancing naturally in the hand. The probe hardware has a single multipurpose button, a single multi-colour functional status LED, and a battery charging port for all day mobility.

The status LED enhances workflow productivity by allowing rapid operator assessment of the cleanliness of the fibre endface - either passing or failing standard rules—as well as "fibre not found" error notification.

"According to industry studies, contaminated fibre endfaces

typically account for 85 percent of optical network failures," explained Maury Wood, product line manager for AFL's Test & Inspection division. *"With the advent of broadband and enterprise data center links at 100 Gbps and higher, the universal adherence to best practice fibre cleaning and inspection methods is an operational imperative. AFL is the leader in the Internet of Test, and the FOCIS WiFi2 is clear evidence of this leadership."*

The FOCIS WiFi2 uses AFL's large portfolio of inspection adapter tips for both connectors and bulkhead sleeves, including all 2.5 mm (SC, FC, ST) and 1.25 mm (LC) ferrules, as well as multi-fibre connectors and bulkhead sleeves (MPO/MTP/MPO16). AFL offers an adapter tip for high density LC PC/UPC optical distribution frames as well.

TRIBUTE - DEREK RONALD WOODBURN



DEREK R WOODBURN
1938 - 2018

Derek Woodburn joined the SAIEE in 1970. A Fellow Member of The South African Institute of Electrical Engineers (SAIEE) for 48 years!

Derek was well known amongst his peers and had served on the SAIEE Council since 1997.

He assisted in the Technical editing of the wattnow magazine. Derek will be sorely missed.

BY I MINX AVRABOS

SAIEE President Jacob Machinjike, the SAIEE Council and staff proffer their sincere condolences to Jeanette and the entire Woodburn family. We would like to use this opportunity to pay tribute to the tremendous contribution Derek Woodburn has made to the electrical engineering fraternity in South Africa, and to the SAIEE.

Derek was born in Pretoria and the elder of two brothers, where he attended Sunnyside Primary and Pretoria Tech. Derek's working career began in 1958 at Iscor Steel Works as an Apprentice Millwright. After a year, he was granted a railway bursary to study engineering, which took him to Durban to study.

He attended the University of KwaZulu Natal and completed his BSc Eng degree in 1964.

In 1967 he joined the South African Airways as a Pupil Engineer where he received training in Avionics Systems which included Flight Data Recorders and Simulators. He then registered as a Professional Engineer in 1969.

Derek started work in 1973, at the Industrial Development Corporation of South Africa as an Electrical Engineer. There he was responsible for assessing the engineering aspects of applications for project funding.

Then during 1996, Derek started working at the City of Johannesburg, where he was deployed as Manager: Supply Development. He was responsible for the safe, reliable and cost-effective operation of the entire Johannesburg electrical power system on a day-to-day basis. He

developed, implemented and managed operation plans to optimise the mix of own and Eskom sourced power for safe loading, operating to accommodate the plant outage need of other divisions.

Derek retired in 2003 and worked as a consultant for various companies thereafter.

During his career, Derek published 10 papers in his field, and numerous others in different fields (many after his retirement), one of which was listed in the British Library of Science. He was the Technical Editor for the wattnow magazine for several years, and was one of the proof-readers of "The History of Electrical Engineering", written by Dirk Vermeulen and published by the SAIEE earlier this year.

He received numerous awards and distinctions from professional societies. Derek was an avid reader having approximately 40 000 electronic books ready to be loaded onto his kindle (the titles of which had been entered into a spreadsheet) and was a fountain of knowledge on all sorts of subjects.

Derek celebrated his 50th year as an Elder in his Church earlier this year.

RESEARCH INTERESTS

- Amateur Rocketry Telemetry and Recovery;
- Astronomy;
- Stress Control in termination of Power;
- Cables.

DISTINCTIONS

- Member of the AMIEE (London).
- Member of ECSA.

- He became a Student member of the SAIEE in 1960.
- Fellow of EASA.
- Fellow of the SAIEE, where he served on SAIEE Council from 1997 to 2018.
- Member of the SAIEE Membership Committee from 1997 to 2018.
- Member of the Education & Training Committee from 1997 to 2005.
- Member of the SAIEE Power Section committee from 1997 - 2003.
- Member of the SAIEE Publications Committee from 2006 to 2018.

Derek was an avid swimmer, and over the last 24 years had swum just over 5700 km, which equated the distance between Johannesburg to Luxor (Egypt) 'as the crow flies.'

HIS SWIMMING CAREER ACHIEVEMENTS ARE:

- Captain of the Randburg Inner-City Games Team in 1996
- He completed the Germiston 1200m Open Water Swims from 1997 to 2005.
- Completed the Midmar Mile Swims in 1997, 1998, 2002, 2004 and 2005.
- He completed swimming competitions in Potchefstroom, Ebenzer Dam, Sun City and Roodeplaat Dam.

Besides being an Electrical Engineer, Derek was a devoted husband to Jeanette whom he met while in Durban, studying Electrical Engineering. They married in 1964, followed by three children namely Louise, Craig and Heather and then became grandparents to nine grandchildren.

Derek was a seasoned traveller and absolutely loved museums. He had a list of all the countries he went to visit - in fact, according to Jeanette, he had a list for almost everything. A comment was made at his memorial, that Steven Hawking died earlier the same day as Derek, and that the two of them, no doubt, had an interesting conversation!

Derek will be greatly missed by all who knew him - the hugger who always had a smile on his face. He never had a bad word to say of anyone and wouldn't hurt a fly.

Derek, your place across my desk is all the emptier now, but I'm sure that you are swimming up a storm. **Wn**



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Transforming Businesses through the use of Artificial Intelligence

Every 25 years or so, a new technology architecture emerges, which changes the way businesses operate and can often transform entire industries. For example, mainframes were the first technology architecture when they were introduced in the 1950s. They enabled industries, such as manufacturing and financial services, to automate processes, which continues today. The technology architecture changed the business architecture because mainframes enabled organizations to use shared services and grow from local to global operations.

BY | PIERRE FOUICHE

The production of microprocessors beginning in the early 1970s enabled the invention of the personal computer about a decade later, which provided computing power at the fingertips of business people, changing the way they worked. In the 1990s, the World Wide Web led to the invention of new ways of selling and doing business over the Internet. What we call cloud computing today started out as network-centric computing two decades ago. Now smart devices, attached through the Internet to massive cloud data centers, have spurred digital businesses in many industries. We're watching a new technology architecture evolve that will result in new business architectures.

As organizations now deal with massive amounts of data, the combination with artificial, or augmented intelligence (AI), is creating the next technology architecture, which is once again changing the way business is conducted. The combination is creating businesses that operate based upon intelligence, not just information, and such intelligence can grow exponentially. Companies of all sizes and across all industries are seizing upon this opportunity. In fact, global spending on AI-related hardware and software is expected to exceed \$57.6 billion in 2021, as compared with the \$12 billion that was spent in 2017, according to IDC.



Insights from AI workloads require new hardware and software paradigms and the infrastructure to deliver data-driven workloads. If the amount of data in the world was considered “big” before, the volume of data required to train a deep learning model is almost unfathomable. The processing power required to operate high-performance analytics that lead to insights dwarfs anything that has come before. While 20 percent of all the data in the world is searchable, 80 percent is not and may be comprised of videos, pictures or even social media. AI is helping organizations tap into the 80 percent -- or what’s called unstructured data -- and combine it with the searchable data to create competitive advantages.

Once again, the technology architecture is changing along with the business architecture and creating a new system of platforms for not only how work gets done, but how separate organization’s platforms

interact in an ecosystem of platforms. Companies that have not started their AI journey should consider doing so quickly or they risk being left behind. Here are six key technology strategies for organizations to consider when transforming their businesses through the use of AI:

- Determine the organization’s core expertise and what factors will differentiate it from its competition.
- Learn to curate the organization’s own data -- and data from other sources -- that will help differentiate its technical architecture and business platforms.
- Recognize that technical architectures matter when designing an organization’s platform for the future.
- Become an agile organization, which means blurring the boundaries between business and technology architectures

and employees, business partners and others in the organization’s ecosystem.

- Be secure to the core of a business because the security of data can fundamentally differentiate an organization from its competitors.

The era of AI not only demands more than tremendous processing power and unprecedented speed, but also requires an open ecosystem of innovative companies to deliver technologies and tools. We believe this new technology architecture will help to fuel industry transformation and generate even more discoveries that benefit the world. **Wn**



Cyber risk management

Although most companies have invested in IT security solutions to protect their networks and data, these tend to focus on mitigating the most common threats like viruses and malware and fall short of addressing more sinister risks such as fraud, identity theft and espionage.

These are damaging threats that can put a company's reputation and business continuity at risk and can have serious financial implications. It is only when IT security-related risks are considered as business risks that the relevance of addressing them with proactive, strategic and appropriate solutions really becomes apparent – and this has to come from the top.

“Cyber risks should be treated as business risks and should form part of a company's overall risk management strategy. This has to be a top-down drive; from C-level (Senior Management) employees, for whom the cost of a breach or leak is highest, to everyone else in the organisation that has access to information systems,” says Charl Ueckermann, CEO at AVeS Cyber Security.

Cybercrime is burgeoning rapidly, not only in volume but sophistication as well; while 70% of threats faced by enterprises are known, 30% are unknown, advanced threats that traditional signature-based security technologies alone cannot tackle.

Cybercriminals are also becoming far more discerning and are targeting their attacks. Though more targeted, they often employ basic methods to implement their attacks. These methods can include social engineering, stealing of employee credentials, imitating legitimate software or even using malware covered by a stolen certificate to infiltrate systems. Ransomware, a type of malware that encrypts data and either prevents or limits users from accessing their systems, is typically targeted at C-level employees as well as departments dealing with sensitive information, such as accounts and human resource departments. These types of advanced, targeted cyber incidents are becoming more prevalent – even in South Africa.



“With this in mind, it becomes quite clear that organisations need a multi-disciplinary approach that is aligned with their specific risk management requirements and includes the implementation of appropriate IT security solutions, ongoing monitoring, analysis of IT security intelligence, and employee education. Regardless of how expensive or robust the IT security technologies are, they will not be fully effective unless everybody throughout the enterprise, starting at the top, understands the risks and supports the IT security strategy,” says Ueckermann.

He offers this advice to C-level employees for managing IT security risks to their organisations:

1. Understand that the threat landscape has changed and keeps on changing. With cyber security threats and



business risks increasing, treat IT security risks as business risks. Traditional, signature-based security technologies are not enough to address these risks; don't bring a knife to a gun fight.

2. Be pro-active and prepared to avoid reactive firefighting after a breach or leak. Consult with IT security experts to help identify potential risks and implement the most appropriate and effective solutions to support your risk management strategy.
3. Understand that it is impossible to predict exactly how your systems might be attacked or threatened. You need an adaptive system with machine learning and pattern recognition capabilities, to deal with evolving threats.
4. Aim for Machine / Man symbiosis; use computers for their strengths, but don't neglect to leverage the intuition of your people. There are things a computer can

do that even the smartest person in the world can't, but there are things a child can do that a computer cannot.

5. Get expert advice and support to understand, defend and deal with advanced threats like zero-day attacks.
6. Conduct regular vulnerability assessments of your IT infrastructure. This will help you to uncover the loopholes in your organisation's security architecture and avoid damage that could be caused by cyber-attacks.
7. More than 80% of all cyber incidents are caused by human error. Make sure all employees are trained and are informed of risks that can occur. Companies lose money recovering from staff-related incidents, yet education and training programmes intended to prevent these problems are limited, and they usually fail to engender the desired behaviour and motivation. When employees are

educated about the potential risks associated with clicking on links in emails, responding to phishing mails, connecting unsecured devices to company IT resources or sharing access credentials, they are less likely to put systems in danger.

*"To put organisations at ease, there are various computer-based training products available that leverage modern learning techniques and address all levels of the organisational structure", says Ueckermann. "Every individual in the organisation using a computer is responsible for IT security, not just the IT department. Cybersecurity awareness and education are, therefore, fundamental to the effectiveness of your risk management strategy," he concludes. **wn***

2018 Trends for SME's

What are the trends Small and Medium Enterprises (SME's) can look out for in this year's economy? The good news is, SME's in South Africa can be profitable even though the economic forecast is grim.

BY | HEINRICH VAN DER VYVER

"Knowing the real South Africa is to know, and be familiar with, the ambitious entrepreneurial spirit that runs through its tributaries and flows like a river into the heart of a nation." - Avi Lasarow of DNAFit Life Sciences.

Our country is known for its entrepreneurial heart, and proudly so. It came as a shock then when the Global Entrepreneurship Monitor ranked South Africa among the lowest when it comes to the perception of business opportunities or entrepreneurial intent by young people. More accurately though it showed that necessity-based entrepreneurship, not viewed to be job-creating or growth-oriented, has increased due to high unemployment levels and slow economic growth. Interestingly, the more qualitative Global Entrepreneurship Index placed South Africa as an entrepreneurial leader in sub-Saharan Africa, second only to Botswana.

The Allan Gray Orbis Foundation and the South African Breweries (SAB) Foundation report showed that entrepreneurs in South Africa have succeeded, in spite of structural challenges, the country's slow GDP growth rate and the mass of large firms overshadowing the business market, to

produce some of the most successful enterprises on the continent. It also showed that South Africa is on a par with other middle-income countries around the world when it comes to entrepreneurship levels.

We are fortunate to have SME development as a key objective on the national government agenda, and that most corporates are eager to look to smaller businesses as part of the procurement policies. As 2018 shifts into second gear, here are some important insights that SME's and business owners should consider in order to grow their businesses.

DIGITAL TREND

Worldwide retail e-commerce sales reached US\$2.290tn in 2017, some 10.1% of all retail sales, and are set to hit \$4.479tn by 2021. Consumers and businesses are rapidly migrating services to digital channels for its efficiency, convenience and scalability. This includes basic elements like digitising accounting processes with software, through to using social media for marketing.

If you're a little nervous to take the first step to digital, you can't go wrong by putting yourself in





your customers' shoes and reflecting on your business through their eyes. Does digital make their lives easier? Yes. Does it make you appear more professional and 'together'? Definitely.

In fact, it's been shown that clients attribute more credibility to companies that use a single system or ERP to run their business with.

Plus, with cloud hosting you can run your business from anywhere, and ensure your customers always get the best service.

Going digital is one way for SME's to level the playing field with the bigger competitors. It's time to stop using excel to run your business.

CUSTOMER EXPERIENCE AND PERSONALISATION

According to a report by Boston Consulting Group, retailers that have implemented personalisation strategies see sales gains of 6 - 10%, at a rate two to three times faster than other retailers.

There are all kinds of ways to do it; your online store can show suggestions of other products they might like, based on their previous purchases. Email marketing can be segmented into user-interest groups for a more tailored sales approach.

The key here is to have effective Customer Relationship Management (CRM) software that tracks customer interactions with your business, that will help you implement your customer experience and personalisation strategies.

This will ensure their next interaction with you is as personalised, and satisfying, as possible.

DIFFERENTIATION BEATS HANDOUTS

The World Bank recently predicted that South Africa will grow at roughly 1.1% in 2018 and, while its not cast in stone, it's a relatively firm indicator that there are no handouts coming from the economy this year. It's up to us SME's to put shoulder to the wheel and make it work.

Our focus should mainly be on differentiating ourselves from our competitors and getting the word out through marketing.

Saying that, try not to differentiate on price alone. There's no need to constantly give discounts or specials if your product or service is worth the price you are charging. These days offering great service may be the only thing necessary to make new customers and keep them coming back. If you combine this with good quality, and easy accessibility to your products and services, you should have the advantage over your competitors.

Finally, more than ever it's time to arm yourself with the right business systems, business coaches, and as much information and insight you can in order to grow your businesses this year.

Let's make 2018 the year South African entrepreneurs get settled and grow into successful SME's. **wn**

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ABOUT THE RESEARCH

In 2017, Accenture partnered with the Gordon Institute of Business Science (GIBS) to survey 28 senior executives from leading South African companies in 12 manufacturing and production industries. These 28 executives were part of a larger survey group of close to 1,000 senior executives from large industrial companies across 21 different nations, including South Africa.

Moreover, we complemented the survey data with detailed anecdotal evidence from South African business leaders through roundtable discussions conducted by GIBS.

The survey sought to understand:

- How digital technologies are being deployed by South African companies to drive efficiencies and better customer experiences;
- Challenges that South African businesses face in deploying digital technologies; and
- The maturity of capabilities in South African companies to use digital technologies to drive efficiency and serve customers better.

Industrial output continues to decline, while unemployment remains high and levels of capital investment are much lower compared with emerging-market peers. (see Figure 2).

What is most troubling is the performance of South Africa's manufacturing sector, where growth has been flat for a decade and was negative for three consecutive quarters, falling an average of 3.3% beginning the third quarter of 2016, and expanded marginally (by 1.5%) in Q2 of 2017.¹ This stagnation has both economic and policy implications, given the role of manufacturing in the government's plans for economic transformation and job creation.¹¹

COMPANIES CAN'T WIN BY USING "ME-TOO" STRATEGIES

When we looked for explanations for the limited results from digitisation in South African industries, it quickly became clear that a major problem is that companies have been trying to mimic what leading corporations in advanced economies are doing. Using approaches employed by large organisations in advanced economies is not a recipe for success locally. South African companies continue to struggle with digitisation because "we try and follow companies such as Google, Amazon and Tesla with a 'me-too' mindset," says the chief information officer of a leading South African bank.

One of the main issues with me-too strategies is that they do not allow South African businesses to use digital technologies to better understand and serve local customer needs - and find ways to accelerate growth. In our research, "a lack of intimate, accurate and continuous

knowledge about their clients and context" was the most pressing concern. "Executives must firmly define and unpack what digitalisation truly means for their organisations and customise their offerings according to customer needs," says the chief operating officer of a major South African asset management firm.

THE OPPORTUNITY

Combining digital technologies to leapfrog emerging-market rivals

Nevertheless, there are also advantages in how South African companies are positioned: relatively smaller in size and not bound by massive legacy systems, they have an opportunity to be agile and leapfrog their competitors in the transition to digital-led growth. Also, they are embarking on the digital journey at a time when technology costs are plummeting. With relative ease, industrial companies in South Africa can now adopt a mix of advanced digital technologies such as artificial intelligence, 3D printing, blockchain, and big data analytics to create new customer experiences, develop new revenue streams, and increase operational efficiency.

By using these technologies in combination and implementing them broadly - not just in discrete functions - companies can multiply the financial gains. Our global research finds that if industrial companies combine digital technologies they can achieve significant top-line and bottom-line growth. For instance, we estimate that companies in the natural resources sector could cut down the total cost per employee by almost 16 percent, if they combine artificial intelligence, blockchain, digital twin, machine learning and autonomous

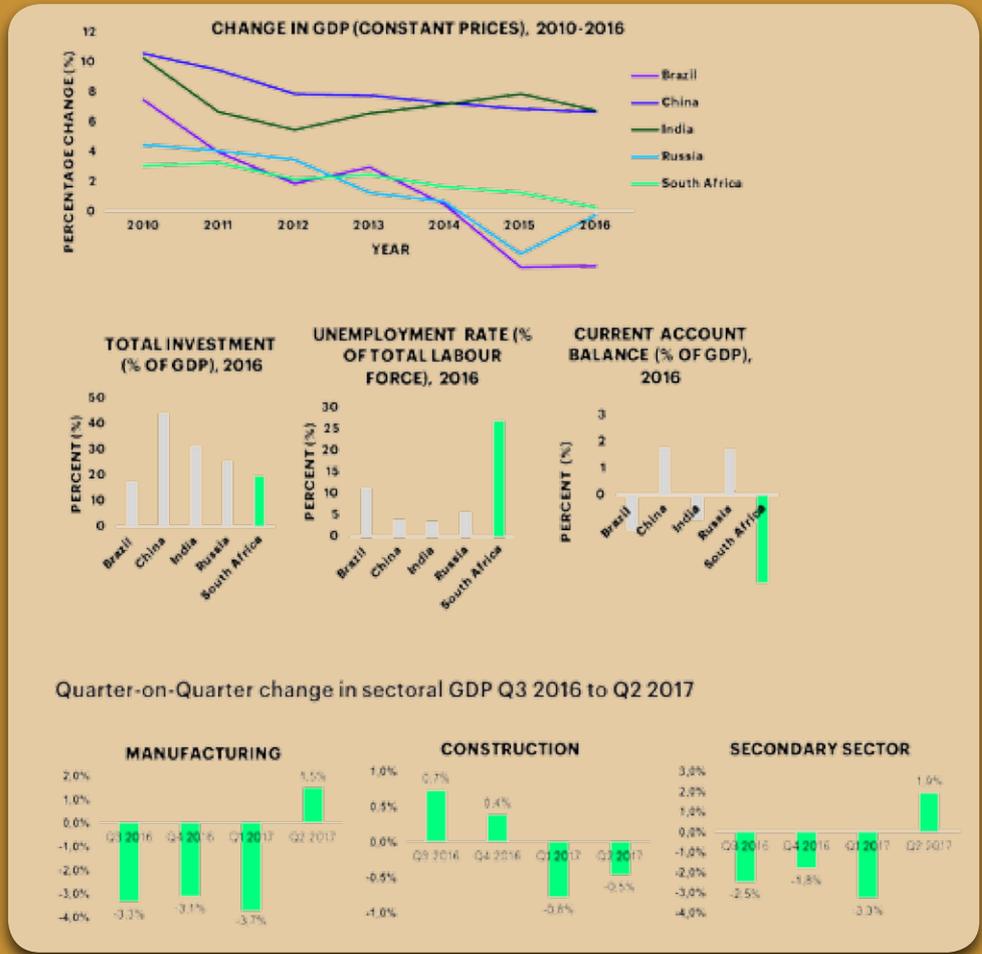


Figure 2: South Africa's digital prowess is yet to translate into industrial gain

vehicles. For South African natural resource companies, this would translate into total savings of over US\$972 million on average given their employee strength of just over 12,500 people.

We also estimated how similar technology combinations could boost market value for manufacturers across industries. Energy companies we surveyed globally, could grow their market value by almost 44 percent if they combined technologies such as virtual reality, big data and artificial intelligence. (See Figure 3).

MOVING BUSINESSES TO INDUSTRY X.0

Selecting the appropriate combination of technologies for a particular type of business is only one part of the digital reinvention of industry. For South African companies to generate the improvements that will enable them to leapfrog to digital leadership, they also must completely reinvent their operating models and rethink production and value chains. To succeed, companies need to move to what we call Industry X.0, which is the full digital reinvention of how companies and industries work.

What's more, Industry X.0 isn't only meant for large industrial companies. It is relevant for companies of all sizes, across all industries. The only prerequisite is an ambition to lead in the new with digital.

Industry X.0 means moving beyond "digital transformation"- experimenting with technologies in specific functions and implementing digital solutions for the sake of digitisation. Industry X.0 businesses make almost every element of their production systems self-monitoring, data-generating, and "aware" of their context.

These companies build digital architectures that enable adaptive interactions between machines, customers, and employees, which lead to ever-better user experiences. And Industry X.0 companies have distinctive cultures: they embrace continuous change.

There are six digital imperatives South African businesses must address to become Industry X.0 organisations. Each of these imperatives has three components, which we illustrate (where possible) with examples from South Africa.

TRANSFORM THE CORE

Industry X.0 companies build core engineering and production systems around digital technologies that drive new levels of efficiency. They ensure that physical machines and software systems are synchronised to unlock previously-unseen cost efficiencies—thus driving up investment capacity.

Integrating for a connected value chain:

Integrate hardware and software to digitally connect processes, platforms, and people across the value chain. Collaborate with partners to digitally connect people and

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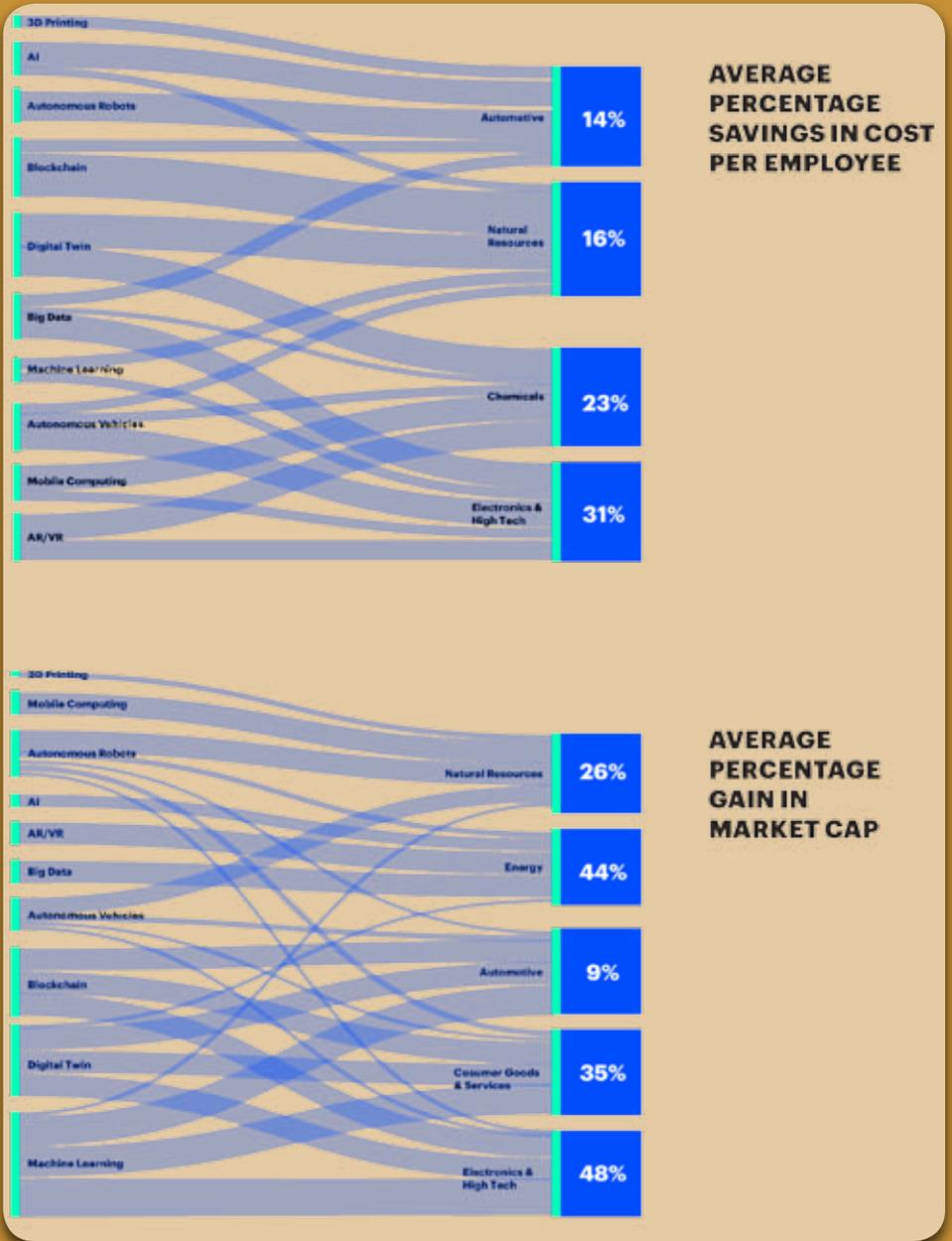


Figure 3: Systematically combining digital technologies can help South African companies unlock significant gains.

processes to find new value creation opportunities.

GE South Africa has partnered with a number of companies across industry sectors, not only to supply industrial equipment but also to provide software

solutions that integrate the entire value chain. In power generation, while GE supplies mainstream equipment such as turbines for both coal-powered and gas-powered stations, it also extends technology solutions to ensure long-term reliability and plant performance. Working

with Sasol, GE developed a novel wastewater cleaning technology which makes it reusable for industrial purposes.^{III} In Durban, GE installed gas engines at landfill sites to convert waste methane gas into electricity and supplies it back to the local power grid.^{IV}

Strategic digital alignment: Ensuring consistent understanding and deployment of digital strategy across the company and ecosystem partners with enhanced focus on digital trust and security.

South Africa's leading cement company, PPC, deployed a firm-wide IT control framework called COBIT 5 (Control Objectives for Information and related Technologies) to improve digital governance. It has allowed PPC's CIO to streamline and standardise all digital technology investments.^V Moreover, it not only enables easy financial audit of digital/IT systems, but also regularly updates protocols for maintaining information security and digital trust.^{VI}

Automation at scale: Automate at scale to optimise production runs and improve Overall Equipment Effectiveness (OEE). Invest in automation not only to reduce run times but also to enhance customer and workforce experiences.

Sasol, an integrated chemicals and energy company, recently piloted a digital customer experience platform called the Digital Catalyst. The platform is designed to help the chemicals business improve customer experiences by automating many planning, scheduling, and order-management processes. In addition, Sasol is also deploying smart sensors in its warehouses to reduce time needed to conduct quality



assurances, thereby improving warehouse efficiency.^{VII}

FOCUS ON CUSTOMER EXPERIENCES AND OUTCOMES

Industry X.0 companies invest in creating hyper-personalised experience for customers using multiple “smart” touchpoints. This helps grow core businesses by enhancing customer engagement.

Big data analytics: Using big data as the foundation for real-time insight generation and decision support across organisational levels - from shop floor operators right up to the board of directors.

In 2014, MTN, a South African telecom operator, partnered with Flytxt, a big data solutions provider. Together, they deployed Flytxt’s real-time decision making and customer engagement solution across MTNs network.

The tool enables MTN to respond to subscriber’s actions and requests instantaneously. The system can detect meaningful customer-initiated events (such as service requests) across the network and trigger relevant actions in real time, thereby enhancing customer experience.^{VIII}

Hyper-personalisation: Designing and deploying products/services/platforms that constantly adapt to meet changing customer needs. Use technologies such as sensors, analytics and AI to sense, understand and react to customer needs.

To build stronger customer engagement, insurance provider Discovery introduced Vitality Active Rewards, a program that rewards its customers for staying active and maintaining a healthy lifestyle. The

app uses 35 million patient-years of health data, to recommend personalised fitness goals based on the customer’s age, fitness, and medical history. The app works with various mobile devices and fitness trackers to monitor progress toward goals. The program also includes incentives such as cash-back rewards on purchases of flights, food, shoes etc.^X

Smart touchpoints: Enhancing customer experience through the use of digital interfaces that allow for smart touchpoints throughout the product lifecycle. Multi, smart touchpoints allow companies to track a variety of user interactions be it at the time of purchase, during usage, at the time of repair, or even at end-of-product life.

One of South Africa’s largest banks, FNB, has used mobile apps to expand its customer base and enhance customer experience. Its mobile banking program goes well beyond standard functions such as account management, online transfers, and service requests. For example, the mobile app now has an AR (Augmented Reality) platform which uses the phone’s camera to overlay information about partner retail stores onto actual physical surroundings and project it on the phone’s screen.

Customers passing by storefronts can check the app to find stores that accept FNB’s eBucks rewards points, and can also see opening and closing times and store contact details instantly.

Customers can also take pictures of their cars and get resale value estimates via the mobile phone app. And, customers can also use the app to pay traffic fines and renew driving licenses.^{XI}

INNOVATE BUSINESS MODELS

Industry X.0 companies ideate and create new business models to drive differentiated value for their clients and new revenue streams for themselves. Such companies inculcate an innovation mindset across the organisation, allowing every employee to contribute ideas towards enhancing customer experience.

Incubating as-a-service business model: Incubating as-a-service business models, by leveraging software-based-services and pay-per-use revenue models.

Industrial equipment companies have an opportunity to transition from simply selling equipment to selling equipment-as-a-service. The original model for this is the “power by the hour” approach pioneered by jet engine manufacturers.

With IoT sensors embedded in their equipment, suppliers of all sorts of industrial equipment can create similar offerings, which reduces capital investment for customers and expands markets to smaller customers - or even one-time users. Equipment makers can generate additional revenue streams by offering predictive maintenance and other services, while also creating a better customer experience.

Machine-to-machine synergies: Leveraging the Industrial Internet to extract sharper insights and find new sources of value, at the level of the workforce and/or customers.

IoT.nxt, a Pretoria-based IoT company is helping clients connect disparate installed digital and IT systems. The technology-agnostic Raptor 1000 gateway platform, connects both IP-based as well as analog devices, drastically reducing costs of

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deploying IoT systems compared with “rip and replace” approaches. South African meat producer Cavalier is using the platform to monitor previously siloed, sensor data from feedlots, abattoirs, and packaging plants, as well as from security and access-control systems.

Employees can see what’s happening with a mobile app. IoT.nxt has already deployed the same IoT platform at a correctional facility, an automotive plant, and at a large coal mine.^{xii}

Reinvention of the product: Building connected, intelligent products from scratch, and embedding intelligence into existing products, to allow for adaptive ecosystem interactions.

Homefarm has created a hydroponic appliance that makes it possible for city dwellers to grow fresh produce, all year round in their homes. Users can grow household plants and herbs inside the climate-controlled box, which automatically regulates the environment depending on whether the crop is a winter or a summer crop. The Homefarm app also connects to the owner’s smartphone over wi-fi and issues reminders when to add water and notifies owners when it is time to harvest.^{xiii}

BUILD A DIGITAL-READY WORKFORCE

Industry X.0 companies recruit, train, and retain talent with skills for the digital enterprise and encourage collaboration between people and machines. Digital skills are not limited to knowledge of using digital tools or software programs, but also includes intuitive know-how of how to apply those tools to solve real business problems.

Training for digital: Training employees on software engineering, machine learning skills, and other digital skills.

To develop the digital skills that were in short supply in its South African operations, Barclays and other employers such as ABSA Bank and Empire State, a technology consulting firm, supported the launch of “The Digital Academy”.

The academy aims to create learning opportunities for South African youth. As a part of the program, interns learn practical software development skills which helps them build commercial products.^{xiv}

Defining digital roles: Redesigning jobs to include tasks that require employees to use digital tools. Such a redesign must always be done in consultation with the job-holder, to ensure that human-machine synergies are leveraged, without jeopardising human safety or motivation levels.

Digital skills are increasingly needed across functions and levels in any corporation.

For example, a utility company that wants to digitise its production lines may require workers to execute new tasks using new digital tools such as robotic arms or virtual reality glasses.

Similarly, middle management positions in functions such as finance may also require employees to learn new software programs or data visualisation techniques.

Encouraging human-machine collaboration: Redesigning job roles to encourage collaboration between humans and robots and other machines to carry out day-to-day tasks.

Over the years, Kumba Iron Ore, a subsidiary of Anglo American, has introduced many technological innovations at its Kolomela mine in the Northern Cape.

By 2016, Kumba was operating six automated drills in Kolomela, which are expected to reduce drilling costs by 15%. Rather than laying off drill operators, the company has trained them to operate the automated drills remotely, resulting in greater efficiency and lower workplace risks.^{xv}

BUILD NEW ECOSYSTEMS

An Industry X.0 company builds an ecosystem of suppliers, distributors, start-ups, and customers, which allows it to scale new business models rapidly.

Ecosystem orchestration: Combining efforts of different business partners (suppliers, peers, distribution) to create a digital value chain. Large industrial companies must assume a collaborative approach to innovation. Despite their size and technological prowess, they must act with empathy and allow creative freedom to smaller ecosystem partners.

Telkom is investing in local enterprises, new suppliers, and existing partners through its FutureMakers program. Since May 2015, the telecom carrier has invested in strategic start-ups and small businesses that develop relevant technologies. The program provides risk capital, physical space and connectivity solutions, and technical expertise for startups.^{xvi}

Tech incubation centers and centers of excellence: Industry X.0 companies nurture innovation clusters that design and prototype early-stage technology use cases.

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In 2016, GE launched its first Africa Innovation Center (AIC) in Johannesburg, with the aim of incubating sustainable local innovations for the Sub-Saharan region. Within a year of its inception, it was already making commercial impact.

Together with GE's mining division, the University of Pretoria, and a sensor manufacturer, the AIC ran a pilot program for a mining equipment manufacturer to deliver a remote-monitoring software platform. The platform would enable remote monitoring of equipment condition and wear and tear, allowing for timely maintenance and replacement.^{xvii}

Open innovation and co-creation: Obtaining and developing ideas for new products or services from a wide variety of sources, both internal and external. Open innovation and co-creation works best when it is not a one-time engagement. Ongoing investment in co-created idea development is an imperative.

In 2017, the South African National Space Agency (SANSA) and Airbus launched an open innovation challenge for entrepreneurs, universities, and start-ups. The goal was to develop novel uses for earth observation data obtained by satellites. Finalists in the competition will work with specialists from Airbus and will be given access to observation data to develop their ideas.^{xviii}

PIVOT WISELY

Industry X.0 companies are moving into the future, but as they do so, they carefully balance investment and resource allocation between the core business and new businesses to synchronise innovation and growth.

Digital native c-suite: Building a leadership team, that is passionate about and is capable of envisioning the use of advanced digital tools in a variety of strategic and tactical initiatives.

In late 2016, telecom operator MTN positively reacted to its poor financial performance by adding a new C-level position through the appointment of a new Chief Digital Officer. Hired from outside the firm, the appointment reflected the increasing demand for candidates who have a cross-industry perspective along with a robust experience in defining and deploying digital strategies. The move seems to have paid off, as MTN experienced a 3.1% growth in earnings for the first half of 2017, performing especially well in digital services such as Mobile Money.^{xx}

Establishing a cadence for digital investment: Systematically and continuously investing in digital technologies and injecting digital tools into mainstream operations.

South African banking major Capitec invested close to US\$22 million to acquire 40 percent stake in Latvian online lending platform Cream Finance.

Thinking ahead of the curve, Capitec expects to build digital-only, international banking operations through this strategic investment. This move may further enhance its existing position as South Africa's best digital bank.^{xxii}

Digital performance management: Updating performance metrics for the digital enterprise.

To succeed as digital enterprises, companies

must look beyond traditional productivity and efficiency measures, and identify new ones that make the most of the big data and advanced analytics capabilities available to them. In Industry X.0 organisations performance metrics should measure the abilities of digital technology as well as the digital workforce to improve both the top and bottom line.

INDUSTRY X.0 BUSINESSES ARE BEST POSITIONED TO COMBINE DIGITAL TECHNOLOGIES

To drive new levels of efficiency, new sources of growth, and deliver new customer experiences. Becoming an Industry X.0 business is a journey. It starts by taking steps to become smart, connected, living and learning, and it culminates in the digital reinvention of industry.

For South Africa, the Industry X.0 journey holds out even greater promise - to reignite industrial growth that is needed to keep steady on the path of development. South African companies must learn from their peers; some of whom have already begun their Industry X.0 journeys. It is imperative to embark on this journey today to emerge as digital winners of tomorrow. **Wn**

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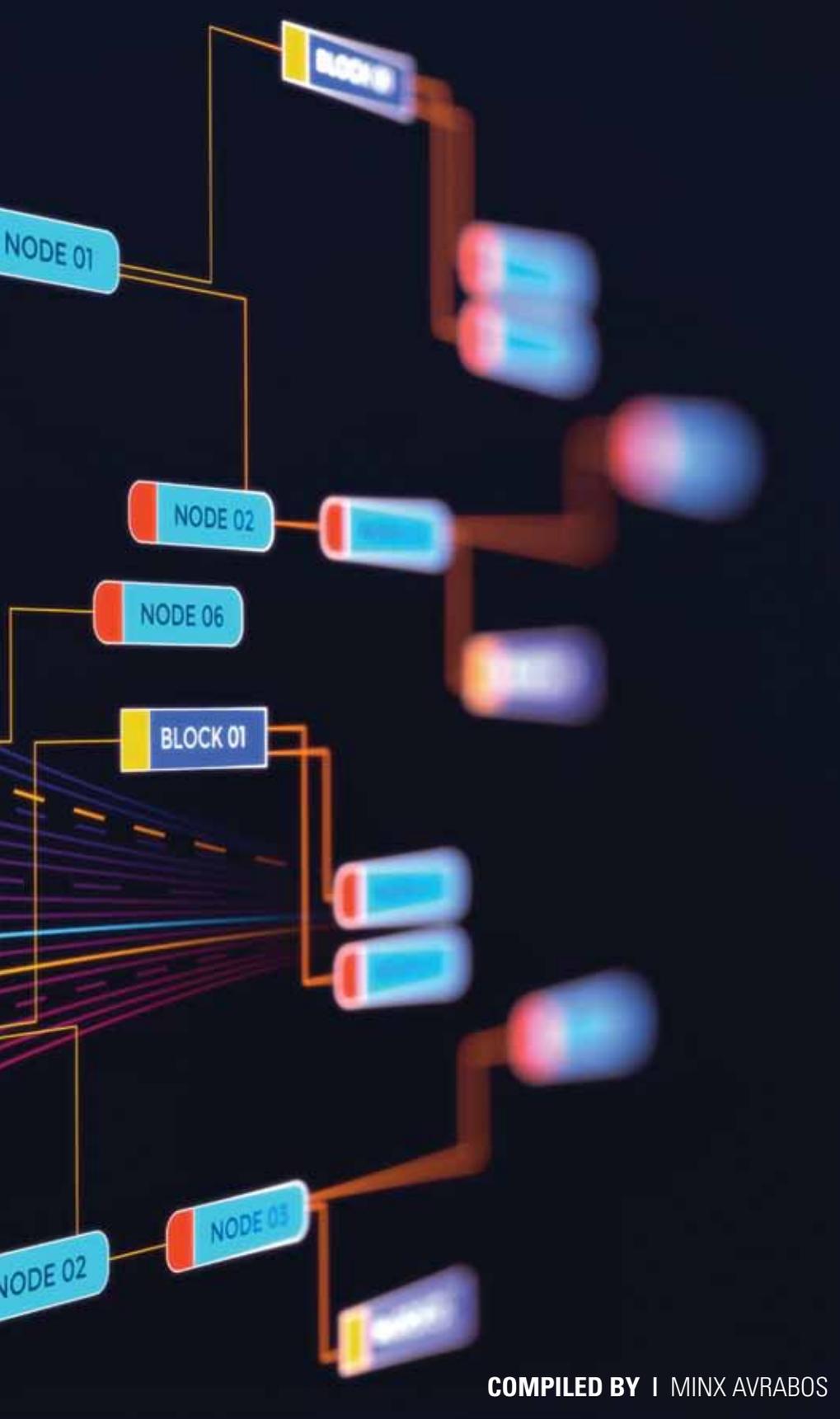
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What is Blockchain Technology?

Is Blockchain Technology the new internet? The blockchain is an undeniably ingenious invention – the brainchild of a person or group of people known by the pseudonym, Satoshi Nakamoto.



On a P2P Foundation profile, Nakamoto claimed to be a man living in Japan, born on 5 April 1975. Speculation about the true identity of Nakamoto has mostly focused on a number of cryptography and computer science experts of non-Japanese descent, living in the United States and Europe. Satoshi Nakamoto also created the bitcointalk forum, posted the first message in 2009 under the pseudonym satoshi.

In October 2008, Nakamoto published a paper on the cryptography mailing list at metzdowd.com describing the bitcoin digital currency. It was titled “Bitcoin: A Peer-to-Peer Electronic Cash System”. In January 2009, Nakamoto released the first bitcoin software that launched the network and the first units of the bitcoin cryptocurrency, called bitcoins. Satoshi Nakamoto released the Version 0.1 of bitcoin software on Sourceforge on 9 January 2009.

Nakamoto claimed that work on the writing of the code began in 2007. The inventor of Bitcoin knew that due to its nature, the core design would have to be able to support a broad range of transaction types. The implemented solution enabled specialized codes and data fields from the start through the use of a predicative script.

Nakamoto created a website with the domain name bitcoin.org and continued to collaborate with other developers on the bitcoin software until mid-2010. Around this time, he handed over control of the source code repository and network alert key to Gavin Andresen, transferred several related domains to various prominent members of the bitcoin community, and stopped his involvement in the project. Until shortly before his absence and handover, Nakamoto made all modifications to the source code himself.

The inventor left a text message in the first mined block which reads ‘*The Times 3 January 2009 Chancellor on brink of second bailout for banks*’. The text refers to a headline in The Times published on 3 January 2009. It is a strong indication that the first block was mined no earlier than

Blockchain Technology

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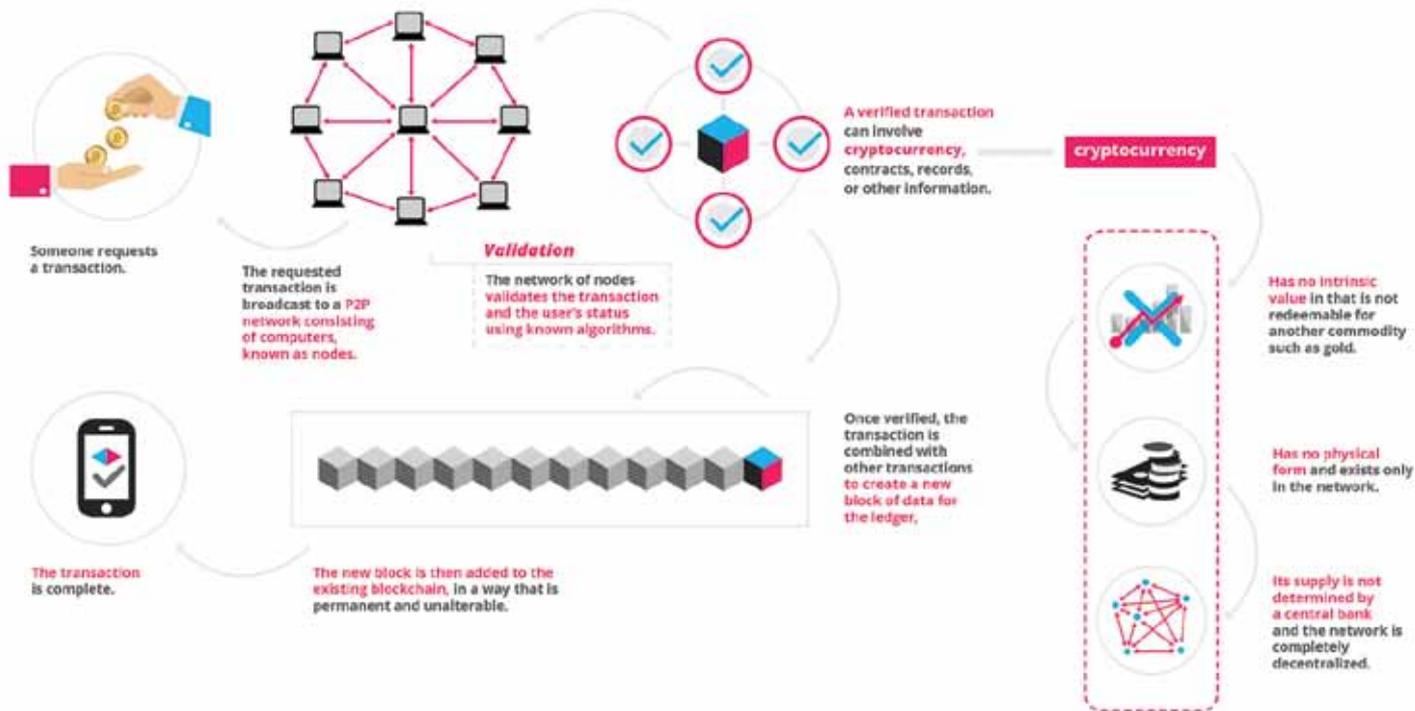


Figure 1: What is Blockchain Technology? A step-by-step guide than anyone can understand

this date. The genesis block has a timestamp of 18:15:05 GMT on 3 January 2009. This block is unlike all other blocks in that it doesn't have a previous block to reference. This required the use of custom code to mine it. Timestamps for subsequent blocks indicate that Nakamoto did not try to mine all the early blocks solely for himself.

As the sole, predominant early miner, the inventor was awarded bitcoin at genesis and for 10 days afterwards. Except for test transactions these remain unspent since mid January 2009. The public bitcoin transaction log shows that Nakamoto's known addresses contain roughly one million bitcoins. As of 17 December 2017, this is worth over 19 billion USD. This makes him the 44th richest person on Earth.

But since then, it has evolved into something greater, and the main question every single person is asking is: What is Blockchain?

By allowing digital information to be distributed but not copied, blockchain technology created the backbone of a new type of internet. Originally devised for the digital currency, Bitcoin, the tech community is now finding other potential uses for the technology.

Bitcoin has been called "digital gold," and for a good reason. To date, the total value of the currency is close to \$9 billion US. And blockchains can make other types of digital value. Like the internet (or your car), you don't need to know how the blockchain works to use it. However, having a basic knowledge of this new technology shows why it's considered revolutionary.

"The blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value." - Don & Alex Tapscott, authors Blockchain Revolution (2016)

A DISTRIBUTED DATABASE

Picture a spreadsheet that is duplicated thousands of times across a network of computers. Then imagine that this network is designed to regularly update this spreadsheet and you have a basic understanding of the blockchain.

Information held on a blockchain exists as a shared - and continually reconciled - database. This is a way of using the network that has obvious benefits. The blockchain database isn't stored in any single location, meaning the records it keeps are truly public



and easily verifiable. No centralized version of this information exists for a hacker to corrupt. Hosted by millions of computers simultaneously, its data is accessible to anyone on the internet.

To go in deeper with the Google spreadsheet analogy, I would like you to read this piece from a blockchain specialist.

BLOCKCHAIN AS GOOGLE DOCS

The traditional way of sharing documents with collaboration is to send a Microsoft Word document to another recipient, and ask them to make revisions to it.

The problem with that scenario is that you need to wait until receiving a return copy before you can see or make other changes because you are locked out of editing it until the other person is done with it. That's how databases work today. Two owners can't be messing with the same record at once.

That's how banks maintain money balances and transfers; they briefly lock access (or decrease the balance) while they make a transfer, then update the other side, then re-open access (or update again). With Google Docs (or Google Sheets), both parties have access to the same document at the same time, and the single version of that document is always visible to both of them. It is like a shared ledger, but it is a shared document. The distributed part comes into play when sharing involves a number of people.

Imagine the number of legal documents that should be used that way. Instead of passing them to each other, losing track of versions, and not being in sync with the other version, why can't **all** business documents become shared instead of

transferred back and forth? So many types of legal contracts would be ideal for that kind of workflow. You don't need a blockchain to share documents, but the shared documents analogy is a powerful one.

BLOCKCHAIN DURABILITY AND ROBUSTNESS

Blockchain technology is like the internet in that it has a built-in robustness. By storing blocks of information that are identical across its network, the blockchain cannot:

- Be controlled by any single entity.
- Has no single point of failure.

Bitcoin was invented in 2008. Since that time, the Bitcoin blockchain has operated without significant disruption. (To date, any of problems associated with Bitcoin have been due to hacking or mismanagement. In other words, these problems come from bad intention and human error, not flaws in the underlying concepts.)

The internet itself has proven to be durable for almost 30 years. It's a track record that bodes well for blockchain technology as it continues to be developed.

"As revolutionary as it sounds, Blockchain truly is a mechanism to bring everyone to the highest degree of accountability. No more missed transactions, human or machine errors, or even an exchange that was not done with the consent of the parties involved. Above anything else, the most critical area where Blockchain helps is to guarantee the validity of a transaction by recording it not only on a main register but a connected distributed system of registers, all of which are connected through a secure validation mechanism." – Ian Khan, TEDx Speaker | Author | Technology Futurist

TRANSPARENT AND INCORRUPTIBLE

The blockchain network lives in a state of consensus, one that automatically checks in with itself every ten minutes. A kind of self-auditing ecosystem of a digital value, the network reconciles every transaction that happens in ten-minute intervals. Each group of these transactions is referred to as a "block". Two important properties result from this:

- Transparency data is embedded within the network as a whole, by definition it is public.
- It cannot be corrupted altering any unit of information on the blockchain would mean using a huge amount of computing power to override the entire network.

In theory, this could be possible. In practice, it's unlikely to happen. Taking control of the system to capture Bitcoins, for instance, would also have the effect of destroying their value.

"Blockchain solves the problem of manipulation. When I speak about it in the West, people say they trust Google, Facebook, or their banks. But the rest of the world doesn't trust organizations and corporations that much — I mean Africa, India, the Eastern Europe, or Russia. It's not about the places where people are really rich. Blockchain's opportunities are the highest in the countries that haven't reached that level yet." - Vitalik Buterin, inventor of Ethereum

A NETWORK OF NODES

A network of so-called computing "nodes" make up the blockchain.

Node (computer connected to the blockchain network using a client that performs the task of validating and relaying

Blockchain Technology

continues from page 35



Figure 2: Node

transactions) gets a copy of the blockchain, which gets downloaded automatically upon joining the blockchain network.

Together they create a powerful second-level network, a wholly different vision for how the internet can function.

Every node is an “administrator” of the blockchain, and joins the network voluntarily (in this sense, the network is decentralized). However, each one has an incentive for participating in the network: the chance of winning Bitcoins.

Nodes are said to be “mining” Bitcoin, but the term is something of a misnomer. In fact, each one is competing to win Bitcoins by solving computational puzzles. Bitcoin was the *raison d'être* of the blockchain as it was originally conceived. It's now recognized to be only the first of many potential applications of the technology. There are an estimated 700 Bitcoin-like cryptocurrencies (exchangeable value tokens) already available. As well, a range of other potential adaptations of the original blockchain concept are currently active, or in development.

“Bitcoin has the same character a fax machine had. A single fax machine is a doorstep. The world where everyone has a fax machine is an immensely valuable thing.”

- Larry Summers, Former US Secretary of the Treasury

THE IDEA OF DECENTRALIZATION

By design, the blockchain is a decentralized technology.

Anything that happens on it is a function of the network as a whole. Some important implications stem from this.

By creating a new way to verify transactions aspects of traditional commerce could become unnecessary. Stock market trades become almost simultaneous on the blockchain, for instance - or it could make types of record keeping, like a land registry, fully public. And decentralization is already a reality.

A global network of computers uses blockchain technology to jointly manage the database that records Bitcoin transactions. That is, Bitcoin is managed by its network, and not any one central authority. Decentralization means the network operates on a user-to-user (or peer-to-peer) basis. The forms of mass collaboration this makes possible are just beginning to be investigated.

“I think decentralized networks will be the next huge wave in technology.” - Melanie Swan, author *Blockchain: Blueprint for a New Economy* (2015)

WHO WILL USE THE BLOCKCHAIN?

As web infrastructure, you don't need to know about the blockchain for it to be useful in your life.

Currently, finance offers the strongest use cases for the technology. International remittances, for instance. The World Bank estimates that over \$430 billion US in money transfers were sent in 2015. And at the moment there is a high demand for blockchain developers.

The blockchain potentially cuts out the middleman for these types of transactions. Personal computing became accessible to the general public with the invention of the Graphical User Interface (GUI), which took the form of a “desktop”. Similarly, the most common GUI devised for the blockchain are the so-called “wallet” applications, which people use to buy things with Bitcoin, and store it along with other cryptocurrencies.

Transactions online are closely connected to the processes of identity verification. It is easy to imagine that wallet apps will transform in the coming years to include other types of identity management.

“Online identity and reputation will be decentralized. We will own the data that belongs to us.” - William Mougayar, author *The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology* (2016)

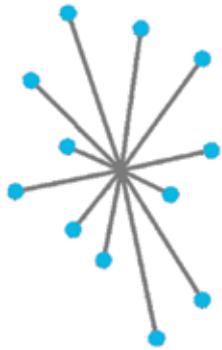
THE BLOCKCHAIN & ENHANCED SECURITY

By storing data across its network, the blockchain eliminates the risks that come with data being held centrally.

Its network lacks centralized points of vulnerability that computer hackers can exploit. Today's internet has security problems that are familiar to everyone. We all rely on the “username/password”



Centralized



Decentralized



Distributed Ledgers



The New Networks

Distributed ledgers can be public or private and vary in their structure and size.

Public blockchains

Require computer processing power to confirm transactions ("mining")

- Users (●) are anonymous
- Each user has a copy of the ledger and participates in confirming transactions independently

- Users (●) are not anonymous
- Permission is required for users to have a copy of the ledger and participate in confirming transactions

Figure 3: Blockchain networks

system to protect our identity and assets online. Blockchain security methods use encryption technology.

The basis for this are the so-called public and private "keys". A "public key" (a long, randomly-generated string of numbers) is a users' address on the blockchain. Bitcoins sent across the network gets recorded as belonging to that address. The "private key" is like a password that gives its owner access to their Bitcoin or other digital assets.

Store your data on the blockchain and it is incorruptible. This is true, although protecting your digital assets will also require safeguarding of your private key by printing it out, creating what's referred to as a paper wallet.

A SECOND-LEVEL NETWORK

With blockchain technology, the web gains a new layer of functionality.

Already, users can transact directly with one another — Bitcoin transactions in 2016 averaged over \$200,000 US per day. With the added security brought by the blockchain new internet business are on track to unbundle the traditional institutions of finance.

Goldman Sachs believes that blockchain technology holds great potential especially to optimize clearing and settlements, and could represent global savings of up to \$6bn per year.

"2017 will be a pivotal year for blockchain tech. Many of the startups in the space will either begin generating revenue – via providing products the market demands/values – or vaporize due to running out of cash. In other words, 2017 should be the year where there is more implementation of products utilizing blockchain tech, and less talk about blockchain tech being the magical pixie dust that can just be sprinkled atop everything. Of course, from a customers viewpoint, this will not be obvious as blockchain tech should dominantly be invisible – even as its features and functionality improve peoples'/ business' lives. I personally am familiar with a number of large-scale blockchain tech use cases that are launching soon/2017. This implementation stage, which 2017 should represent, is a crucial step in the larger

Blockchain Technology

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adoption of blockchain tech, as it will allow skeptics to see the functionality, rather than just hear of its promise.” – George Howard, Associate Professor Brown University, Berklee College of Music and Founder of George Howard Strategic.

THE BLOCKCHAIN A NEW WEB 3.0?

The blockchain gives internet users the ability to create value and authenticates digital information. What will new business applications result?

SMART CONTRACTS

Distributed ledgers enable the coding of simple contracts that will execute when specified conditions are met. Ethereum is an open source blockchain project that was built specifically to realize this possibility. Still, in its early stages, Ethereum has the potential to leverage the usefulness of blockchains on a truly world-changing scale.

At the technology’s current level of development, smart contracts can be programmed to perform simple functions. For instance, a derivative could be paid out when a financial instrument meets certain benchmark, with the use of blockchain technology and Bitcoin enabling the payout to be automated.

THE SHARING ECONOMY

With companies like Uber and AirBnB flourishing, the sharing economy is already a proven success. Currently, however, users who want to hail a ride-sharing service have to rely on an intermediary like Uber. By enabling peer-to-peer payments, the blockchain opens the door to direct interaction between parties — a truly decentralized sharing economy results.

An early example, OpenBazaar uses the blockchain to create a peer-to-peer eBay. Download the app onto your computing device, and you can transact with OpenBazaar vendors without paying transaction fees. The “no rules” ethos of the protocol means that personal reputation will be even more important to business interactions than it currently is on eBay.

CROWDFUNDING

Crowdfunding initiatives like Kickstarter and Gofundme are doing the advance work for the emerging peer-to-peer economy. The popularity of these sites suggests people want to have a direct say in product development. Blockchains take this interest to the next level, potentially creating crowd-sourced venture capital funds.

In 2016, one such experiment, the Ethereum-based DAO (Decentralized Autonomous Organization), raised an astonishing \$200 million USD in just over two months. Participants purchased “DAO tokens” allowing them to vote on smart contract venture capital investments (voting power was proportionate to the number of DAO they were holding). A subsequent hack of project funds proved that the project was launched without proper due diligence, with disastrous consequences. Regardless, the DAO experiment suggests the blockchain has the potential to usher in “a new paradigm of economic cooperation.”

GOVERNANCE

By making the results fully transparent and publicly accessible, distributed database technology could bring full transparency to elections or any other kind of poll taking.

Ethereum-based smart contracts help to automate the process.

The app, Boardroom, enables organizational decision-making to happen on the blockchain. In practice, this means company governance becomes fully transparent and verifiable when managing digital assets, equity or information.

SUPPLY CHAIN AUDITING

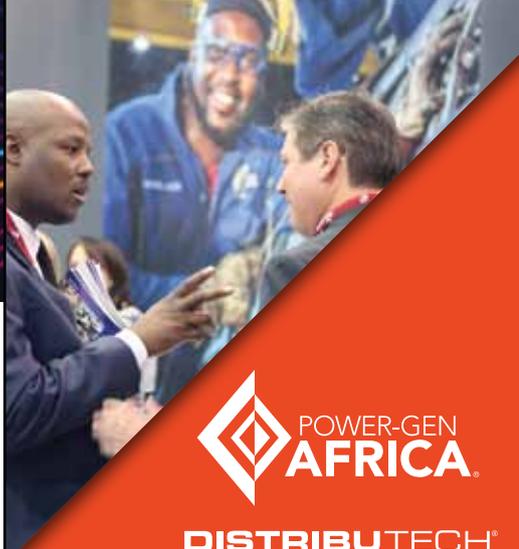
Consumers increasingly want to know that the ethical claims companies make about their products are real. Distributed ledgers provide an easy way to certify that the backstories of the things we buy are genuine. Transparency comes with blockchain-based timestamping of a date and location — on ethical diamonds, for instance — that corresponds to a product number.

The UK-based Provenance offers supply chain auditing for a range of consumer goods. Making use of the Ethereum blockchain, a Provenance pilot project ensures that fish sold in Sushi restaurants in Japan has been sustainably harvested by its suppliers in Indonesia.

FILE STORAGE

Decentralizing file storage on the internet brings clear benefits. Distributing data throughout the network protects files from getting hacked or lost.

Inter Planetary File System (IPFS) makes it easy to conceptualize how a distributed web might operate. Similar to the way a bittorrent moves data around the internet, IPFS gets rid of the need for centralized client-server relationships (i.e., the current web). An internet made up of completely decentralized websites has the potential to speed up file transfer and streaming times. Such an improvement is not only convenient. It’s a necessary upgrade to the



web's currently overloaded content-delivery systems.

PREDICTION MARKETS

The crowdsourcing of predictions on event probability is proven to have a high degree of accuracy. Averaging opinions cancels out the unexamined biases that distort judgment. Prediction markets that payout according to event outcomes are already active. Blockchains are a “wisdom of the crowd” technology that will no doubt find other applications in the years to come.

Still, in Beta, the prediction market application Augur makes share offerings on the outcome of real-world events. Participants can earn money by buying into the correct prediction. The more shares purchased in the correct outcome, the higher the payout will be. With a small commitment of funds (less than a dollar), anyone can ask a question, create a market based on a predicted outcome, and collect half of all transaction fees the market generates.

PROTECTION OF INTELLECTUAL PROPERTY

As is well known, digital information can be infinitely reproduced — and distributed widely thanks to the internet. This has given web users globally a goldmine of free content. However, copyright holders have not been so lucky, losing control over their intellectual property and suffering financially as a consequence. Smart contracts can protect copyright and automate the sale of creative works online, eliminating the risk of file copying and redistribution.

Mycelia uses the blockchain to create a peer-to-peer music distribution system. Founded by the UK singer-songwriter

Imogen Heap, Mycelia enables musicians to sell songs directly to audiences, as well as license samples to producers and divvy up royalties to songwriters and musicians — all of these functions being automated by smart contracts. The capacity of blockchains to issue payments in fractional cryptocurrency amounts (micropayments) suggests this use case for the blockchain has a strong chance of success.

INTERNET OF THINGS (IOT)

What is the IoT? The network-controlled management of certain types of electronic devices — for instance, the monitoring of air temperature in a storage facility. Smart contracts make the automation of remote systems management possible. A combination of software, sensors, and the network facilitates an exchange of data between objects and mechanisms. The result increases system efficiency and improves cost monitoring.

The biggest players in manufacturing, tech and telecommunications are all vying for IoT dominance. Think Samsung, IBM and AT&T. A natural extension of existing infrastructure controlled by incumbents, IoT applications will run the gamut from predictive maintenance of mechanical parts to data analytics, and mass-scale automated systems management.

NEIGHBOURHOOD MICROGRIDS

Blockchain technology enables the buying and selling of the renewable energy generated by neighborhood microgrids. When solar panels make excess energy, Ethereum-based smart contracts automatically redistribute it. Similar types of smart contract automation will have many other applications as the IoT becomes a reality.



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Blockchain Technology

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Located in Brooklyn, Consensus is one of the foremost companies globally that is developing a range of applications for Ethereum. One project they are partnering on is Transactive Grid, working with the distributed energy outfit, LO3. A prototype project currently up and running uses Ethereum smart contracts to automate the monitoring and redistribution of microgrid energy. This so-called “intelligent grid” is an early example of IoT functionality.

IDENTITY MANAGEMENT

There is a definite need for better identity management on the web. The ability to verify your identity is the lynchpin of financial transactions that happen online. However, remedies for the security risks that come with web commerce are imperfect at best. Distributed ledgers offer enhanced methods for proving who you are, along with the possibility to digitize personal documents. Having a secure identity will also be important for online interactions — for instance, in the sharing economy. A good reputation, after all, is the most important condition for conducting transactions online.

Developing digital identity standards is proving to be a highly complex process. Technical challenges aside, a universal online identity solution requires cooperation between private entities and government.

Add to that the need to navigate legal systems in different countries and the problem becomes exponentially difficult. E-Commerce on the internet currently relies on the SSL certificate (the little green lock) for secure transactions on the web. Netki is a startup that aspires to create an SSL standard for the blockchain.

AML AND KYC

Anti-money laundering (AML) and know your customer (KYC) practices have a strong potential for being adapted to the blockchain. Currently, financial institutions must perform a labour intensive multi-step process for each new customer. KYC costs could be reduced through cross-institution client verification, and at the same time increase monitoring and analysis effectiveness.

DATA MANAGEMENT

Today, in exchange for their personal data people can use social media platforms like Facebook for free. In future, users will have the ability to manage and sell the data their online activity generates. Because it can be easily distributed in small fractional amounts, Bitcoin — or something like it — will most likely be the currency that gets used for this type of transaction.

LAND TITLE REGISTRATION

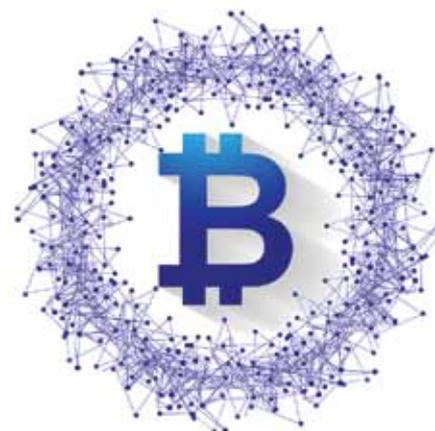
As Publicly-accessible ledgers, blockchains can make all kinds of record-keeping more efficient. Property titles are a case in point. They tend to be susceptible to fraud, as well as costly and labour intensive to administer.

A number of countries are undertaking blockchain-based land registry projects. Honduras was the first government to announce such an initiative in 2015, although the current status of that project is unclear. This year, the Republic of Georgia cemented a deal with the Bitfury Group to develop a blockchain system for property titles. Reportedly, Hernando de Soto, the high-profile economist and property rights advocate, will be advising on the project. Most recently, Sweden announced it was experimenting with a blockchain application for property titles.

STOCK TRADING

The potential for added efficiency in share settlement makes a strong use case for blockchains in stock trading. When executed peer-to-peer, trade confirmations become almost instantaneous (as opposed to taking three days for clearance). Potentially, this means intermediaries — such as the clearing house, auditors and custodians — get removed from the process.

Numerous stock and commodities exchanges are prototyping blockchain applications for the services they offer, including the ASX (Australian Securities Exchange), the Deutsche Börse (Frankfurt’s stock exchange) and the JPX (Japan Exchange Group). Most high profile because the acknowledged first mover in the area, is the Nasdaq’s Linq, a platform for private market trading (typically between pre-IPO startups and investors). A partnership with the blockchain tech company Chain, Linq announced the completion of its first share trade in 2015. More recently, Nasdaq announced the development of a trial blockchain project for proxy voting on the Estonian Stock Market. **wn**



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After decades of unbridled enthusiasm – bordering on addiction – about all things digital, the public may be losing their trust in technology. Online information isn't reliable, whether it appears in the form of news, search results or user reviews.



BY | BHASKAR CHAKRAVORTI | TUFTS UNIVERSITY

Trust in digital technology will be the internet's next frontier, for 2018 and beyond



Social media, in particular, is vulnerable to manipulation by hackers or foreign powers. Personal data isn't necessarily private. And people are increasingly worried about automation and artificial intelligence taking humans' jobs.

Yet, around the world, people are both increasingly dependent on, and distrustful of, digital technology. They don't behave as if they mistrust technology. Instead, people are using technological tools more intensively in all aspects of daily life. In recent research on digital trust in 42 countries (a collaboration between Tufts University's Fletcher School of Law and

Diplomacy, where I work, and Mastercard), my colleagues and I found that this paradox is a global phenomenon.

If today's technology giants don't do anything to address this unease in an environment of growing dependence, people might start looking for more trustworthy companies and systems to use. Then Silicon Valley's powerhouses could see their business boom go bust.

ECONOMIC POWER

Some of the concerns have to do with how big a role the technology companies and their products play in people's lives. U.S.

residents already spend 10 hours a day in front of a screen of some kind. One in five Americans say they are online "almost constantly." The tech companies have enormous reach and power; more than 2 billion people use Facebook every month.

Ninety percent of search queries worldwide go through Google. Chinese e-retailer, Alibaba, organizes the biggest shopping event worldwide every year on Nov. 11, which in 2017 brought in US\$25.3 billion in revenue, more than twice what U.S. retailers sold between Thanksgiving and Cyber Monday in 2016.

Trust in Digital

continues from page 43

This results in enormous wealth. All six companies in the world worth more than \$500 billion are tech firms. The top six most sought-after companies to work for are also in tech (See Fig 1).

Tech stocks are booming, in ways reminiscent of the giddy days of the dot-com bubble of 1997 to 2001. With emerging technologies, including the “internet of things,” self-driving cars, blockchain systems and artificial intelligence, tempting investors and entrepreneurs, the reach and power of the industry is only likely to grow.

This is particularly true because half the world's population is still not online. But networking giant Cisco projects that 58 percent of the world will be online by 2021, and the volume of internet traffic per month per user will grow 150 percent from 2016 to 2021.

All these users will be deciding on how much to trust digital technologies.

DATA, DEMOCRACY AND THE DAY JOB

Even now, the reasons for collective unease about technology are piling up. Consumers are learning to be worried about the security of their personal information: News about a data breach involving 57 million Uber accounts follows on top of reports of a breach of the 145.5 million consumer data records on Equifax and every Yahoo account – 3 billion in all.

Russia was able to meddle with Facebook, Google and Twitter during the 2016 election campaign. That has raised concerns about whether the openness and reach of digital media is a threat to the functioning of democracies.

Another technological threat to society comes from workplace automation. The management consulting firm, McKinsey, estimates that it could displace one-third of the U.S. workforce by 2030, even if a different set of technologies create new “gig” opportunities. The challenge for tech companies is that they operate in global markets and the extent to which these concerns affect behaviors online varies significantly around the world.

MATURE MARKETS DIFFER FROM EMERGING ONES

Our research uncovers some interesting differences in behaviors across geographies. In areas of the world with smaller digital economies and where technology use is still growing rapidly, users tend to exhibit more trusting behaviours online. These users are more likely to stick with a website even if it loads slowly, is hard to use or requires many steps for making an online purchase. This could be because the experience is



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9. L'Oréal
10. Dell Technologies
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25. GE



Managing your supply chain

To most modern manufacturers the management of the supply chain has its own department focusing on the 'just-in-time' stock control system of the components required to produce their end product. It is equally common that effective energy management is looked at by facilities management team on a cost to supply basis.



There are 2 key constituents to the HV grid: cables and switchgear. Both sit there, slowly deteriorating over time until they are either replaced or they fail. There is a way of identifying those elements that are in danger of failing. Partial Discharge....

This is not a well-known phenomenon outside of the electrical community; and is best described as the microscopic ultrasonic and electrical signs left by the breakdown of the insulation.

Realistically you don't need to fully understand what Partial Discharge (PD) is, you just need to be convinced that the monitoring of it can give you early warning of failures in your HV network. Without this testing you are effectively driving a car without a dashboard!

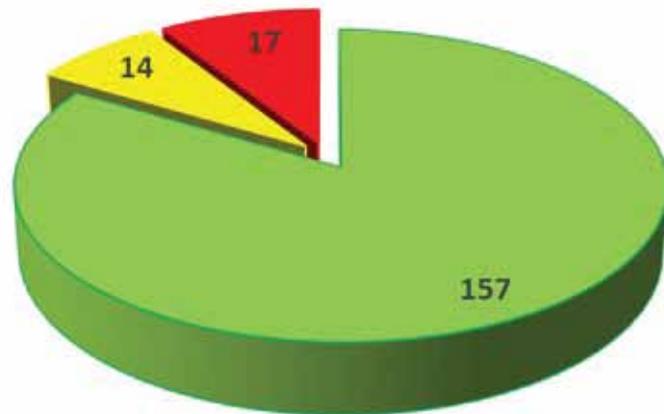
Recent innovations in the technology have been applied to both cables and switchgear with very strong evidence based results.

These results are synopsised below:

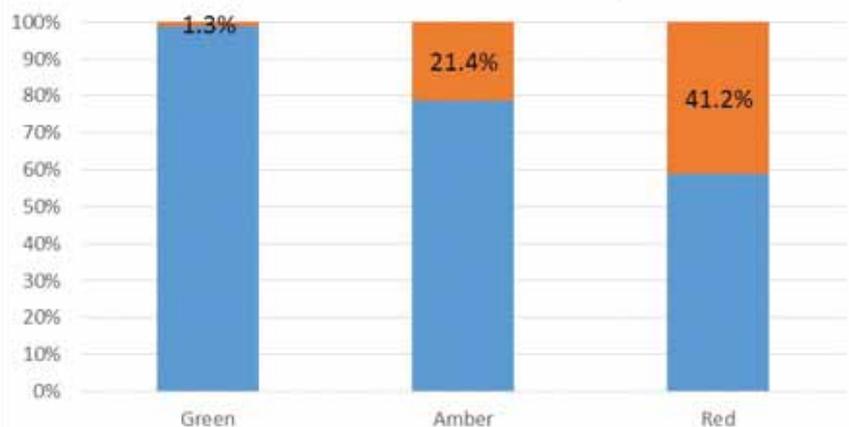
CABLES

A study of nearly 200 high voltage Cables was conducted, with the cables remaining energised and tested in a non-intrusive manner. The cables were categorised Red - Amber - Green according to the partial discharge signatures. Of the 17 cables categorised Red, over 40% of them developed a fault inside of 2 years, of the 14 cables categorised Amber the figure was halved to 20%. Importantly less than 2% of those categorised green had an issue inside the 2 year period. Translate this into risk, if a cable is rated 'Red' then you have a

PD levels recorded on 191 solid 33kV cables tested using on-line Cable Data Collector



% cable faults within 2 years

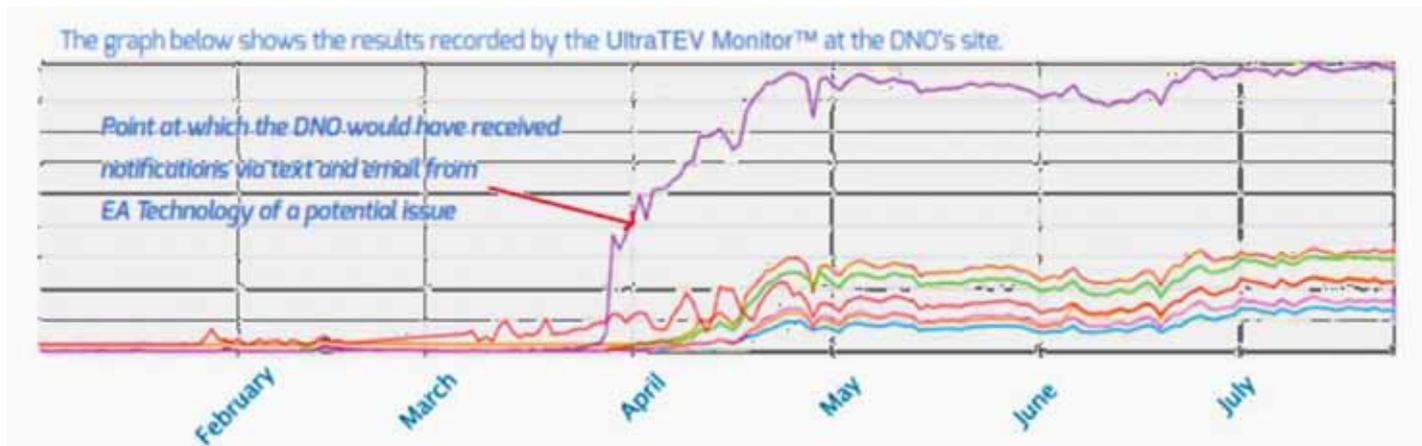


Is it therefore time for you to reassess your energy in terms of viewing it as an essential component whose security of supply chain is as important as the key elements of your production schedule? After all your contracts with your suppliers are likely to have SLA's about delivery, stock levels and potentially penalties for the lack of supply. Electricity is the ultimate in "just-in-time" components you hold no stock, it's delivered to site as need arises and if it fails so does your entire production effort.

It's down to risk management, it's down to criticality, and it's down to the fact that without the high voltage power grid your factory grinds to a halt.

Supply Chain

continues from page 47



50-50 chance of a fault occurring. Armed with this data your CAPEX justification almost writes itself, equally it allows you to focus your engineering team on where the faults are most likely to happen.

SWITCHGEAR

A monitoring system was fitted to a long-term software test to a substation; it had not monitored as it was simply there for software stability tests. The substation failed unexpectedly, leaving 20,000 homes and businesses without power. The data collected during the test showed that PD monitoring would have given almost 4 months' notice of the failure.

Convinced yet? The key is to get the technology to do the work for you, periodic inspections give you a snapshot of the asset health at that discrete moment in time, continual, remote monitoring gives you far more trend analysis and can release your periodic inspection team to more productive tasks.

When you assess the cost-benefit for the finance department, ensure your account for the cost of lost production, the cost to the brand reputation as well as the cost of the replacement equipment. Far better to try to avoid the crisis in the first place!

It isn't just about preventative maintenance, this technology also allows for effective acceptance and assurance testing of new installations and repairs.

The simple to use, handheld partial discharge analyser 'UltraTEV Plus²' has been instrumental to the fault finding and assurance work of solar farms.

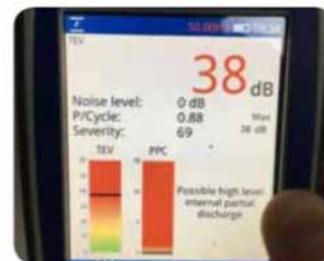
Recently, during routine maintenance, technicians performed a non-intrusive Partial Discharge (PD) assessment using the UltraTEV Plus². The instrument immediately highlighted high PD readings in the substation switchgear cells. The substation was isolated in order to allow access to the cable compartment. Upon removal of the cable termination cover, the origin of the high PD reading was not immediately apparent.

The Extensible Connector was dismantled across all three phases to further investigate the case. Irregularities were noticed on L1.

If UltraTEV Plus² had not been used, the issue would have gone unnoticed and it may have resulted in flashover rendering the switchgear unusable and the cable requiring re-termination. **Wn**



UltraTEV Plus² reading showing the fault at site



Immediate on-screen diagnosis



Partial Discharge identified

Making Partial Discharge measurements easy with the UltraTEV Plus²



Improving the safety and reliability of high voltage switchgear and cables just got easier with the new handheld Partial Discharge measurement instrument.



- Non-intrusively identify, locate and measure Partial Discharge (PD) emissions, which are characteristics of faults that cause failures (85% of substation failures are PD-related)
- Reduce risks and increase safety through early warning detection in MV and HV electrical assets
- Collect detailed information on the condition of key assets, including switchgear and cables
- Use condition data to manage maintenance more efficiently at a lower cost

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Quantum Materials

The science of Condensed Matter Physics had its origins some decades ago. It has subsequently grown to become the most published and cited of all branches of physics.

BY I DUDLEY BASSON

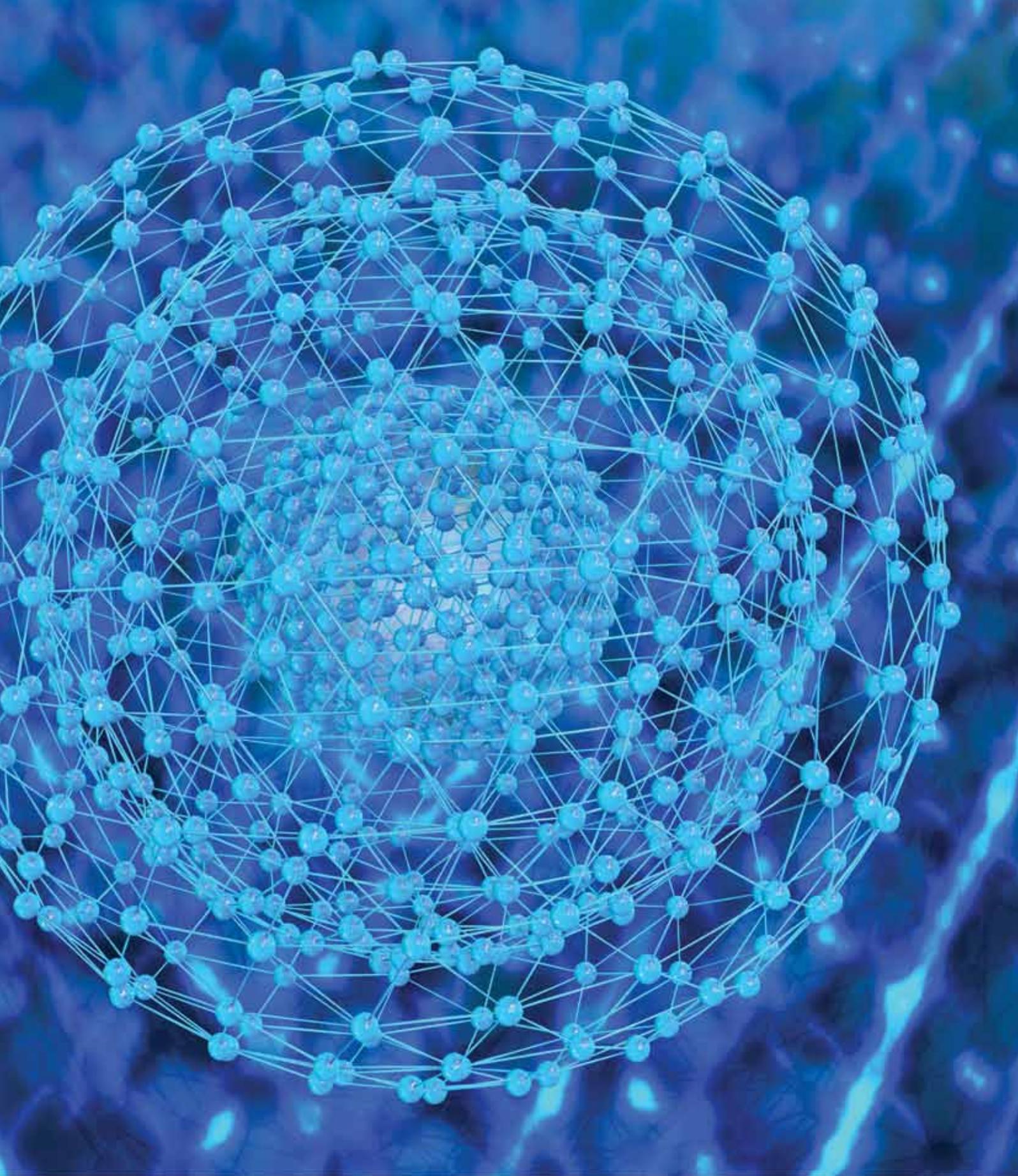
The concept of condensed matter physics was given prominence by the Springer-Verlag journal 'Physics of Condensed Matter' launched in 1963.

Condensed matter physics embraces a holistic, wide spectrum of specialised fields of study. These include the study of the familiar condensed phases of solids and liquids as well as more exotic phases. These phases include superconductivity as well as ferromagnetic and antiferromagnetic phases of spins on crystal lattices of atoms, and the Bose-Einstein condensate found in ultra-cold atomic systems. The studies may employ the use of Dirac's quantum mechanics and the mathematics of algebraic topology. The field overlaps with chemistry, materials science, and nanotechnology, and relates closely to atomic physics and biophysics.

The theoretical physics of condensed matter shares important concepts and methods with that of particle physics and nuclear physics. Condensed Matter Physics also embraces Solid State Physics which included crystallography, metallurgy, elasticity, magnetism, the physical properties of liquids etc. In 1967 the Solid State Theory group at the Cambridge Cavendish Laboratories changed their name to the Theory of Condensed Matter group. The Bell Telephone Laboratories was one of the first institutes to conduct a research program in condensed matter physics.

In 2016 the Nobel Physics Prize was awarded to British scientists Prof David J. Thouless, Dr F. Duncan M. Haldane and Dr J. Michael Kosterlitz for: "*Theoretical discoveries of topological phase transitions and topological phases of matter*". This research included advanced quantum material work on unusual phases of matter such as superconductors, superfluids and thin magnetic films. This was briefly described in the Nov 2016 issue of **wattnow**.





Quantum Materials

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Dr Amalia Coldea, a quantum materials researcher at the University of Oxford declared: *“The word quantum in quantum materials means they have properties that cannot be described by classical physics – we have to invoke quantum physics. We often we refer to materials where there are very strong interactions between their components – you don’t know what properties they will have, and you can’t predict in advance.”*

In a new study, Rice University theoretical physicist Qimiao Si and colleagues at the Rice Centre for Quantum Materials in Houston, USA, and the Vienna University of Technology in Austria made predictions that could help experimental physicists create what the authors have coined a “Weyl-Kondo semimetal”. This is a quantum material with an assorted collection of properties seen in disparate materials like topological insulators, heavy fermion metals and high-temperature superconductors. Quantum materials have various quirky properties, some of which could contribute to future technological innovations like quantum computing – regarded by many as the next revolution in computer technology.

Rice University physicist Hsin-Hua Lai said: *“We really just stumbled upon a model in which, suddenly, we found that the mass had gone from about 1,000 times the mass of an electron to zero.”* A signature characteristic of “Weyl fermions”, elusive quantum particles first proposed by Hermann Weyl more than 80 years ago, is that they have zero mass.

U.S. and European physicists, searching for an explanation for high-temperature superconductivity, were surprised when their theoretical model pointed to the

existence of a never-before-seen material in a different realm of physics: topological quantum materials.

In quantum materials study, the entropy of a closed system can sometimes rise and then return to its original state. This is not a violation of the second law of thermodynamics – this can happen in a statistical system with internal constraints and definite boundaries. This is known as Poincaré recurrence. An interesting demonstration of Poincaré recurrence can be seen in the following Youtube video clip. A series of pendulums with varying swing frequencies is set in motion starting with low entropy with all the pendulums aligned. The pendulums gradually swing with increasing disorder, raising the entropy, and then return to the original state.

WATCH:

<https://www.youtube.com/watch?v=oeVV6-rrj18>

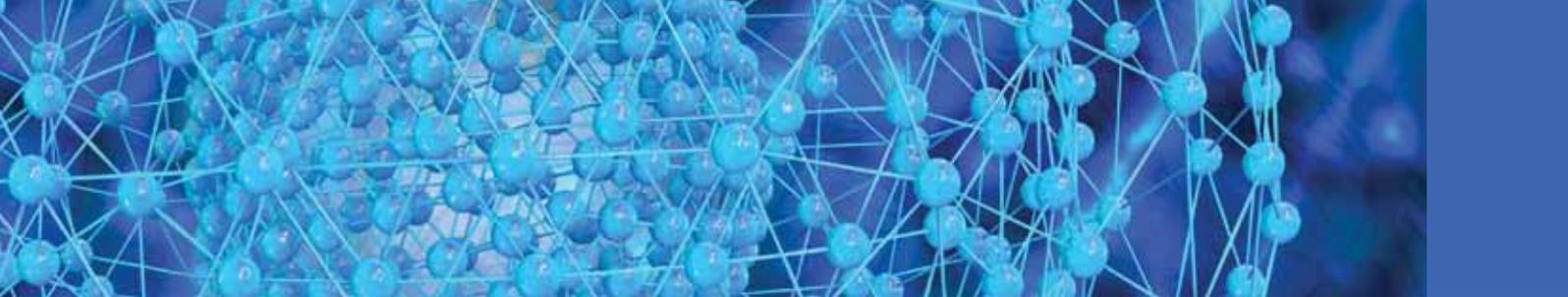
An important field of study in quantum materials is the phenomenon of superconductivity. This is of major significance in engineering, and the phenomenal benefits that it could bring justify the huge efforts in R&D that are being done. There are however two major difficulties obstructing the widespread use of superconductivity: the huge cost of materials and the extreme cryogenic temperatures required. Currently the largest application of superconductivity is in the Large Hadron Collider at CERN near Geneva. This has a 30 km circuit of supercooled superconducting electromagnets with a total mass of 31 000 tons, supercooled to 1,9 K. The magnets, operating at 8,35 tesla, are made of niobium-titanium. The superconductors,

at the finest level, are spider web thin niobium-titanium wires of 6 μm diameter with a copper coating of 0,5 μm .

The Large Hadron Collider (LHC) is described in more detail in the Sept 2016 issue of **wattnow**. Another major use of superconductivity is in the guideways and linear motors of maglev trains. A number of maglev trains have been built. The Shanghai Maglev has a 30,5 km guideway and a top speed of 430 km/h.

The current in a conductor is the result of electrons drifting along the wire. There is a popular misconception that the electrons move along the wire at high speed – this is not the case – the current electrons drift at less than a snail’s pace. It is the voltage or pressure wave that propagates at nearly light speed. As an example, let us consider a wire carrying a current density of 5A per square millimetre. This is a typical density used in motors and other electrical machinery. Using a copper wire, the drift speed would be 36,6 microns (less than half the thickness of copier paper) per second for direct current. In an alternating current the electrons will not drift at all and only oscillate with an amplitude of much less than a micron. It is a sobering thought that all of our huge industrial electrical machinery is driven by invisibly small, and extremely slow, movements of electrons.

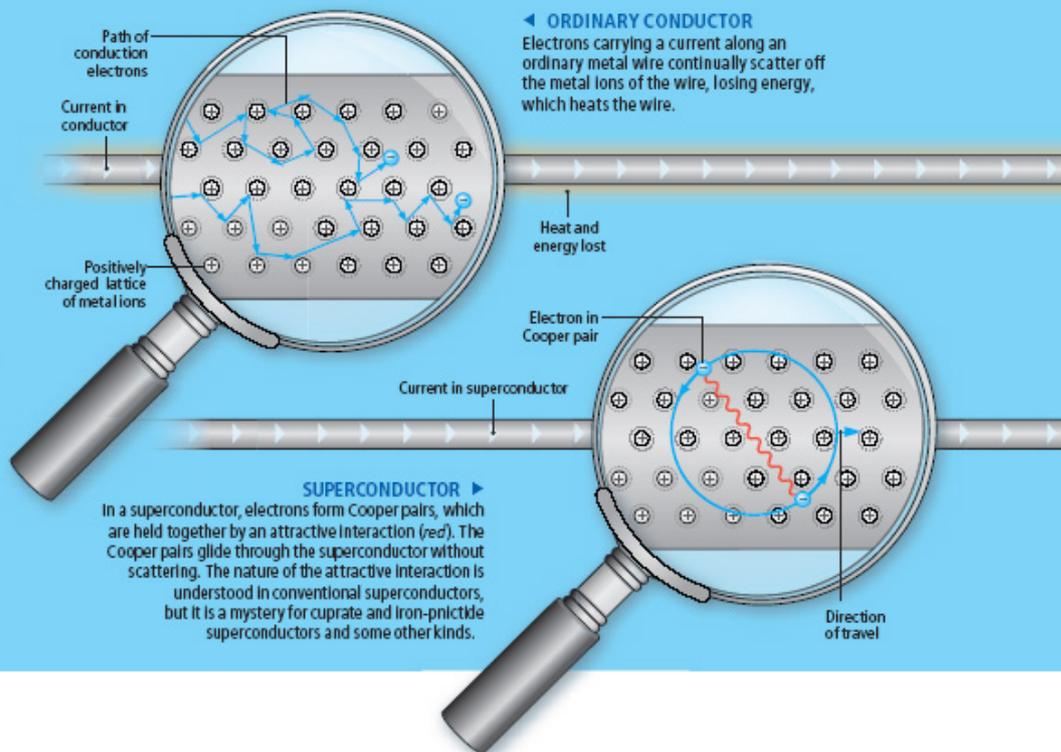
In a metal conductor there are free electrons which are not attached to any particular atom. Copper atoms each contribute one electron to the cloud. The free electrons are however in an extremely turbulent state moving chaotically at an extremely high Fermi velocity of about 1600 km per second. Fermi velocity and Fermi energy are important parameters



[BASICS]

What Makes a Conductor Super

An ordinary conductor drains energy from an electric current because the electrons carrying the current collide with the metal ions of the conductor (top). In a superconductor, in contrast, the electrons form "Cooper pairs" (bottom), all of which collect in a single quantum state of lowest energy, a process known as Bose-Einstein condensation. This sea of Cooper pairs moves as one entity. To dislodge a Cooper pair from this flow requires boosting it to a higher-energy quantum state, and a collision with a metal ion does not involve enough energy to do so. The current therefore flows without energy losses.



in quantum mechanics. These violently moving electrons do not lose their energy to generate heat and do not cause any current drift. This Fermi turbulence remains even when the metal is cooled to cryogenic temperature.

When a direct current flows in a wire this adds a slight slow component of movement to the cloud. This drift movement results in electrons releasing energy quanta to the atoms resulting in heat. In a superconductor, current theory states that electrons are linked in Cooper pairs. At low temperature the pairs have too little energy to release a quantum of energy and hence move without resistance. This

poses an intractable problem for obtaining superconductivity at higher temperatures.

The theory of traditional, low-temperature superconductors was constructed by Bardeen, Cooper, and Schrieffer in 1957, winning them the Nobel physics prize; this theory (known as the BCS theory) had a far-reaching impact, laying the foundation for the Higgs mechanism in particle physics, and it represents one of the greatest triumphs of 20th century physics.

This is not the last word on superconductivity – problems remain in explaining the properties of cuprate and iron pnictide superconductors.

Yttrium barium copper oxide (Yttrium barium cuprate) is a family of crystalline chemical compounds, famous for displaying high-temperature superconductivity. It includes the first material ever discovered to become superconducting above the boiling point of liquid nitrogen (77 K) at about 90 K. Many YBCO compounds have the general formula $YBa_2Cu_3O_{7-x}$

John Tranquada, a physicist and leader of the Neutron Scatter Group in the Condensed Matter Physics and Materials Science Department at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory, where he has been studying cuprates since the 1980s said:

Quantum Materials

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“The ultimate goal is to achieve superconductivity at room temperature. If we want to do that by design, we have to figure out which features are essential for superconductivity. Teasing out those features in such complicated materials as the cuprates is no easy task.”

In April 1986, Georg Bednorz and Karl Müller, working at IBM in Zurich, discovered that certain semiconducting oxides became superconductors at relatively high temperature; in particular, a lanthanum barium copper oxide which becomes superconducting at 35 K. This oxide proved promising, and stimulated the search for related compounds with higher superconducting transition temperatures. In 1987, Bednorz and Müller were jointly awarded the Nobel physics prize for this work.

Taking our understanding of quantum matter to new levels, scientists at Los Alamos National Laboratory are exposing high-temperature superconductors to very high magnetic fields, changing the temperature at which the materials become perfectly conducting and revealing unique properties of these substances.

Brad Ramshaw, a Los Alamos scientist and lead researcher on the project declared: *“High magnetic-field measurements of doped copper-oxide superconductors are paving the way to a new theory of superconductivity.”*

Using the world-record high magnetic fields available at the National High Magnetic Field Laboratory (NHMFL) Pulsed Field Facility, based in Los Alamos, Ramshaw and his co-workers are pushing the boundaries of how matter can conduct electricity without the resistance that

plagues normal materials carrying an electrical current.

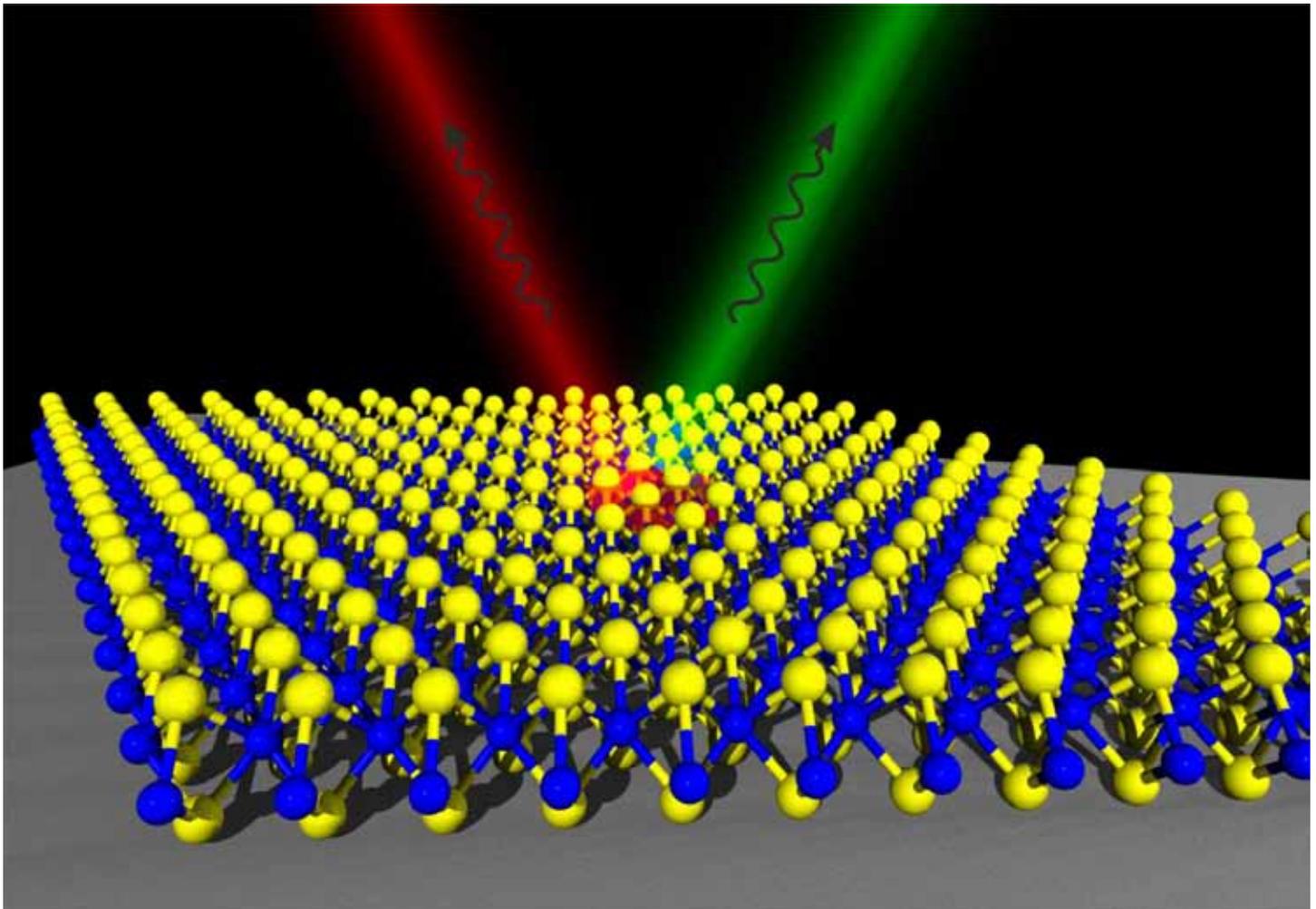
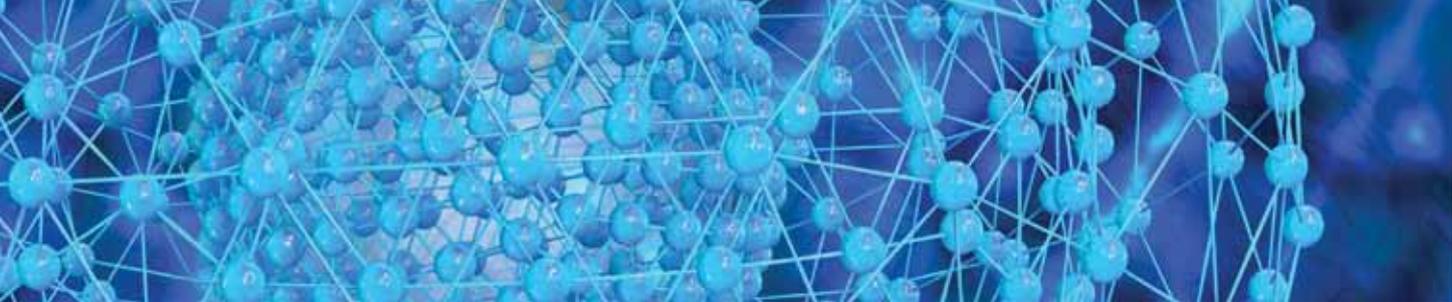
Los Alamos provides unique resources to the Pulsed Magnetic Field Laboratory of the NHMFL in the form of a 1,4 GVA inertial storage motor-generator for high field pulsed magnets. In addition to the 60 tesla Long Pulse Magnet powered by a motor-generator, the NHMFL features capacitor-driven pulsed magnets. In March 2012 a pulsed magnetic field of 100,75 tesla was achieved. Higher pulsed magnetic fields can be achieved by explosive devices but these destroy themselves in the process. MagLab Director Gregory Boebinger, who is also chief scientist for Condensed Matter Science at the National High Magnetic Field Laboratory’s headquarters in Florida, remarked:

“The eventual goal of the research would be to create a superconductor that operates at room temperature and needs no cooling at all. At this point, all devices that make use of superconductors, such as the MRI magnets found in hospitals, must be cooled to temperatures far below zero with liquid nitrogen or helium, adding to the cost and complexity of the enterprise. This is a truly landmark experiment that illuminates a problem of central importance to condensed matter physics. The success of this quintessential MagLab work relied on having the best samples, the highest magnetic fields, the most sensitive techniques, and the inspired creativity of a multi-institutional research team.”

Electrostatic force can be demonstrated by means of a hair comb and scraps of paper and also by rubbing one’s feet on a carpet, but this gives the impression that electrostatic forces are little more than a feeble curiosity; this is a completely false

impression of the immensity of Coulomb forces. Electrostatic force is one of the most powerful in the universe and of unimaginable magnitude. Let us first take a bar of hardened tool steel and try to make an impression on it. A hacksaw or a drill will get you nowhere. About the only way you will be able to cut the bar without heat will be by means of grinding equipment (which will in any case produce much heat). It is electrical forces that are keeping the bar in shape. This is by no means an adequate demonstration of the immensity of electrical forces.

If it were possible to hold two pins, slightly separated, and transfer all the electrons from the one pin head to the other the force between the pinheads would be of astronomical proportions! This is easily calculated but the result is unbelievable. It must be emphasized that this is a thought experiment as there is no physical possibility of transferring the electrons. Let us choose two ordinary dressmaker’s pins with 1 mm heads and hold these separated by 10 mm. The mass of the pinheads is almost entirely due to the nucleons as the mass of the electrons is insignificantly small. Each pinhead will contain about 200 coulombs of electrons. If moved by a pressure of 12 volts, this will be enough electricity to crank and start your car on a cold day. We now imagine that all the electrons are transferred from one pinhead to the other. The resulting force? $3,6 \times 10^{18} \text{N}$ - enough to match the weight of several cubic kilometres of rock! This makes the forces inside even the most violent volcano pale into insignificance. The transfer of electrons will of course also create a voltage difference between the pinheads. How much? It will be millions of times greater than a lightning flash. Here again it would be physically impossible



An illustration shows a beam of light reflecting off from a quantum mirror.

to create or contain such a voltage. While we have the 200 coulombs of electrons handy, let us see what will happen if we release them to the Earth. Let us consider a smooth sphere with the size of the Earth. This will be a spherical capacitor with a capacitance of 700 microfarads. Releasing this charge to the sphere will cause the voltage to rise to 285 kV. A final question about these electrons – how far apart will they be spaced on this huge sphere? About 250 electrons per square centimetre! These figures seem to be pushing the limits of absurdity.

Remarkable research has been done using single atom thick mirrors to reflect light using quantum ‘excitons’. The mirrors were developed at the same time at Harvard University and the Institute for Quantum Electronics in Zurich using sheets of molybdenum diselenide (MoSe_2), each just a single atom thick.

Despite approaching the minimum thickness an object could possibly have and remain reflective under the laws of physics, the tiny mirrors reflected a great deal of the light shone on them. The Harvard mirror,

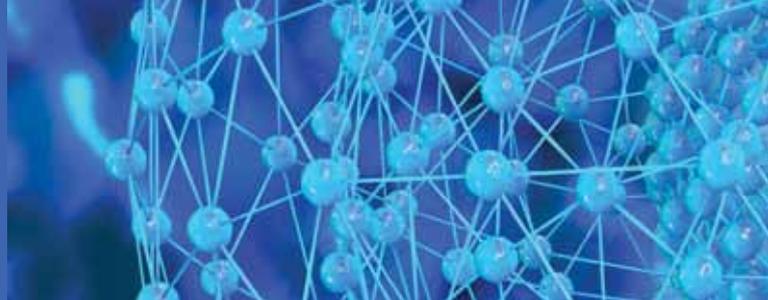
mounted on a silicon base, reflected 85 percent of the light that struck it, and the Zurich mirror, mounted on silica reflected 41 percent. Both mirrors reflected light in the 780 nanometre range, a deep red.

MoSe_2 works as a mirror because of the very specific ways electrons behave as they surround the material’s nuclei. This substance tends to form gaps in its electron fields where an electron could orbit, but no electron is present.

When a photon impacts an atom an
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electron has a good chance of jumping from a lower-energy orbital to a higher-energy orbital. Once that happens, a gap called an “electron hole” forms in the electron field. Electrons surrounding MoSe₂ are especially likely to behave this way when hit by certain wavelengths of light.

The electron holes take on some of the positive charge from the protons in the nuclei. That allows the holes to behave a bit like particles, even though they’re really the absence of particles.

Nearby, negatively charged electrons attract those illusory particles, and under certain circumstances, pair up with them to form bizarre quantum-mechanical objects called excitons. Those excitons emit light of their own, interfering with incoming light and sending it back the way it came.

These ultra-thin mirrors have real-world potential in fibre-optic networks, and other devices that rely on tightly controlling small beams of photons.

Depending on the electrical charge applied to the substance, MoSe₂’s reflectivity goes up or down. If this on-off effect happens fast enough, it could be useful in several high-speed computing applications.

Maxwell’s mathematical theory of electromagnetic radiation showed that light waves were constituted by electric and magnetic fields oscillating at right angles to each other. At the time this was considered to be the all-time greatest achievement in theoretical physics.

Max Planck’s quantum theory showed later that light also had a corpuscular nature. The corpuscles came to be known as photons.

The photon quantum energy could be simply be determined by multiplying the frequency by the famous Planck’s constant ‘h’.

A fundamental feature of light beams is that the beams can pass through each other without the slightest interference taking place between the photons of the beams.

New research shows that photons can indeed react with each other. This could well open a path toward using photons in quantum computing.

In a paper published in February 2018, the team, led by Vladan Vuletic, the Lester Wolfe Professor of Physics at MIT, and Professor Mikhail Lukin from Harvard University, reports that they had observed groups of three photons interacting and, in effect, sticking together to form a completely new kind of photonic matter. In controlled experiments, the researchers found that when they shone a very weak laser beam through a dense cloud of rubidium atoms, cooled to one microkelvin, rather than exiting the cloud as single, randomly spaced photons, the photons bound together in pairs or triplets, suggesting some kind of interaction - in this case, attraction - taking place among them.

While photons normally have no mass and travel at 300,000 kilometers per second, the researchers found that the bound photons actually acquired a fraction of an electron’s mass. These newly weighed-down light particles were also relatively sluggish, traveling about 100 000 times slower than normal non-interacting photons.

Going forward, the team will look for ways to coerce other interactions such as repulsion, where photons may scatter off

each other like billiard balls.

Vuletic commented: *“It’s completely novel in the sense that we don’t even know sometimes qualitatively what to expect. With repulsion of photons, can they be such that they form a regular pattern, like a crystal of light? Or will something else happen? It’s very much uncharted territory.”*

Graphene is one of the most remarkable of quantum materials currently being researched. This is an allotropic form of carbon consisting of a single layer of carbon atoms arranged in a hexagonal lattice. It was observed as early as 1962, and then rediscovered, isolated and characterised in 2004 by Andre Geim and Konstantin Novoselov of the University of Manchester. They then won the 2010 Nobel Prize in Physics.

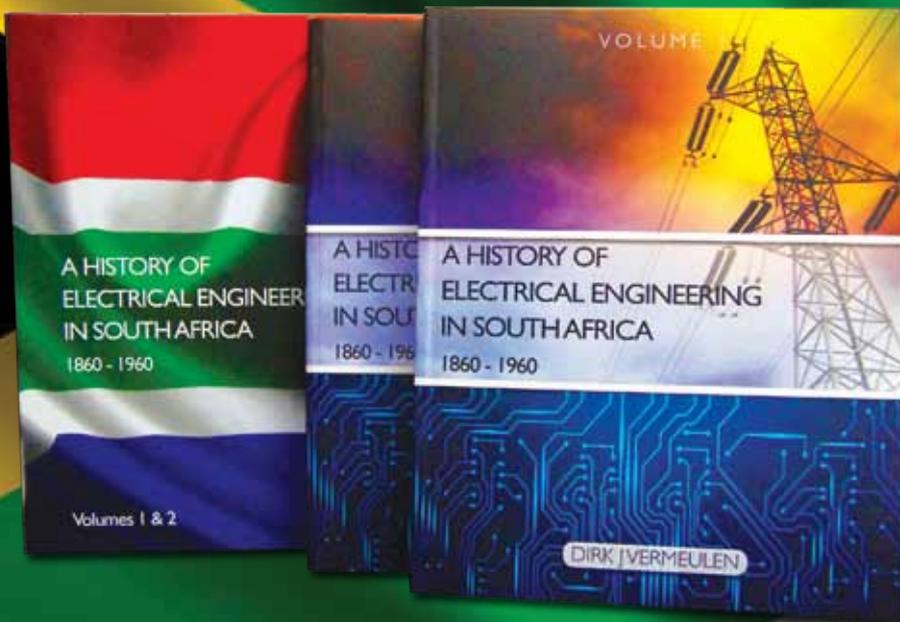
It has most unusual properties. It is the strongest material ever tested and is an efficient conductor of heat and electricity, it is nearly transparent and can self-repair holes in the sheets. It has a specific surface area of 2630 square metres per gram. Electrons propagating through graphene’s honeycomb lattice effectively lose their mass, producing quasi particles that are described by a 2D analogue of the Dirac equation rather than the Schrödinger equation for spin-½ particles. A prediction published in 2015 suggested a melting point of ≈4125 K. Recent and more sophisticated modelling has increased this temperature to at least 5000 K. An exciting possibility would be to thread a DNA molecule through graphene to provide high speed DNA sequencing. **wn**

For more info, visit www.wikipedia.org/wiki/Graphene

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The Overlooked Potential of Rural Spaces and Consumers

Rural areas are arguably the most overlooked spaces in Africa.

This is true both in terms of government services as well as corporate attention. Decision-makers have very little access to credible information about these remote rural spaces, and as a result, they can be tempted to act on misconceptions about an area's economic activity, population, needs, and potential.

BY | DUSTIN HOMER | DIRECTOR OF CLIENT SERVICES | FRAYM

Whether true or not, misconceptions and sparse data can make rural areas unattractive prospects for investment, sales, and corporate expansion.

Yet, it's a mistake to rule out rural spaces and consumers, especially in Africa. Global commerce is fiercely competitive, with business leaders and investors still waking to the vast potential of Africa's burgeoning consumer market. The continent, now home to more than 1.1 billion people, will account for one-fifth of the world's population by 2025. Sub-Saharan Africa's population stood at 1.03 billion last year. What's especially significant is that well over 637 million – 61.6% – of these men, women and children live in rural areas.

61.6% is a massive consumer segment to neglect simply because of inadequate information. This is particularly true in the case of Digital Banking, a

business sector that has much to gain from, and offer, the hard-to-reach regions of developing nations. Geospatial analysis methods provide vital illumination for business leaders and investors by filling crucial gaps in their understanding of rural African consumers.

RURAL AND POOR ARE NOT THE SAME THING

The opinion that “rural” always equates with “poor” is no longer sound. More and more Africans are entering the consumer class, and many of these are in peri-urban or rural areas, creating appealing new investment opportunities. Moreover, it's too simplistic to view elevation in economic status as stemming solely from traditional rural-to-urban migration. Over the past two decades, the discovery of resource-abundant areas in Africa has drawn workers away from cities to rural zones, where they



establish economically vibrant centres. This has certainly been the case in Zambia, with the expansion of mining investment in the territory. Even those who uphold rural-to-urban movement patterns continue to maintain their traditional homes, properties and fields. As their income has increased, so too has their investment in the countryside.

Migration in Africa is a multi-direction process, transporting consumers and their capital with it – including to rural areas. Good data on these emerging rural consumers can illustrate promising opportunities that may not be immediately visible from the outset.

DIGITAL BANKING: A POSTER CHILD FOR RURAL BUSINESS OPPORTUNITY

One of the areas where rural potential has been identified by investors is mobile financial services. The rise of Digital Banking in the region has been spurred by Sub-Saharan Africa's status as the fastest growing mobile market in the world. 420 million unique mobile subscribers were recorded in 2016, along with 731 million SIM connections, and a SIM penetration rate of 74%. By 2020, those same figures are expected to jump to 535 million subscribers, and almost 1 billion SIM connections (85% penetration).

Building on this widespread communications availability, mobile-facilitated monetary transactions help to create a more financially inclusive society. In terms of rural populations, the move to Digital Banking has multiple benefits. There is the time-saving convenience, of course, of no longer having to travel to physical bank buildings in urban centres to perform transactions. Ease of use has also streamlined the movement of funds between developed and undeveloped areas,

matching population migration patterns in both directions. The result is a more interconnected Digital Economy, where the contribution of rural areas is more noticeable at a national level, and more likely to gain notice from other future investors.

There certainly has been Digital Banking buy-in throughout Africa. In cash-strapped Zimbabwe, Econet's EcoCash, a mobile-enabled funds transfer service, became so popular that by mid-2017 electronic money counted for 70% of all financial transactions in the country. In the rest of the region, over 140 mobile money services, including cross-border remittance systems, were in place by the end of 2016.

EFFECTIVE DATA COLLECTION STRATEGIES FOR RURAL SPACES

Obvious investment potential exists – from Digital Banking to FMCG – but gathering information on rural spaces and consumers can be daunting at first if you are restricted to traditional methods like household surveys. The effort and expense to reach out-of-the-way locations makes this approach unfeasible for most companies.

Geospatial analysis overcomes these hurdles by using sophisticated algorithms which are applied to already-existing data sets, such as census data, surveys, and satellite imagery. No need to scavenge for more information.

A crucial part of the process is the use of geospatial co-ordinates. In Fraym's case, multiple data sets and analyses are applied to areas as small as one square kilometer, to generate precise information on populations. This way, it becomes possible to pinpoint new customers, size potential markets, and locate new sites for stores or projects. In terms of Digital Banking prospects, useful data points to

apply in analyses could include existing communications technologies, mobile network reach and the location of rural SMEs with much to gain from digital banking.

Hyper-local results gained from geospatial analysis are often surprising. In one recent incident, a Fraym analysis revealed a high-potential advertising zone in a rural area that would have been overlooked if only district-level statistics had been used. The key to success is pinpointing the potential of the growing communities and neighborhoods within large rural provinces and districts.

Ultra-precision is especially valuable in rural spaces, which tend to be vast and lacking in conventional structure. And over time, the machine learning behind the analytical algorithms becomes extremely accurate – capable of making predictions about areas that were not heavily surveyed, for example. This functionality has huge benefits for lesser-visited and lesser-documented rural spaces. As a specific Digital Banking example, pushing data science techniques have helped to identify half a million Ghanaians in the Volta region who are ready to adopt digital financial services. Three-quarters of these adopters live in rural parts of Volta, in far-flung settlements like Jambo and Kpandai.

BENEFITS FOR EVERYONE

The greater the investment made into rural Africa, the more everyone involved will benefit, from the businesses expanding their reach, to the locals presented with more choices – particularly in relation to their financial security. With a combination of relevant data and cutting-edge analysis, truly profitable decisions can be made. It's time to end to the era of anecdotes guiding your attitudes toward rural spaces. **Wn**

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

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

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

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

We look forward to hearing from you.
- Ed



QUESTION ONE

What determines the useful lifetime of my electric motor?

ANSWER ONE

Considering that an electric motor is a simply designed and ruggedly constructed machine, its lifetime will exclusively depend on the integrity of the insulation system. The integrity of the motor insulation system is affected by several factors including operating temperature, vibration, moisture and operating in corrosive environments.

The operating temperature of the insulating material is the most critical factor determining the useful motor lifetime. For example, the motor lifetime will be reduced by half if the motor is subjected to an additional 10°C of operational temperature above the rated temperature class of the insulation material.

When the operational temperature is consistently above the rated temperature, permanent aging of the insulation material will occur with it becoming dry and losing its insulation properties. As a result of this, the insulation material will no longer withstand the voltage applied to it causing a short circuit condition. It must be mentioned that when we refer to motor

lifetime reduction, we do not specifically refer to the excessively high temperatures from which insulation failures result.

Experience has proved that the motor insulation can last practically indefinitely if the operating temperature is kept below the insulation system limit. Operational temperature increases above the insulation limit will reduce the insulation life time proportionally. The Insulation temperature limit also refers to the hottest spot on the insulation and not necessarily to the whole insulation system. On the other hand, a single weak spot in the insulation is enough to damage the winding completely.

With the increasing use of Variable Speed Drives (VSDs) to control the speed of electric motors, additional precautionary criteria for motor insulation should be considered for the preservation of the electric motor insulation system.

QUESTION TWO

Does my VSD influence the working temperature of my electric motor?

ANSWER TWO

The working temperature of an electric motor will increase when it is fed by a VSD instead of being fed by a sinusoidal voltage



supply. This rise in temperature results from increased motor losses caused by the high harmonic components of the Pulse Width Modulation (PWM) signal and also often by reduced heat transfer resulting from speed reduction of self-ventilated motors.

Solutions to prevent the motor from overheating when fed by a VSD include :

- Motor rated torque derating
- The use of an independent cooling system, also known as a forced cooler
- Use of the “Optimal Flux Solution” (exclusive to applications using WEG VSDs and motors).

QUESTION THREE

Are all electric motors suitable to be used with a VSD?

ANSWER THREE

Not all standard electric motors are suitable to be used with VSDs as the motor insulation systems are susceptible to insulation damage caused by the harsh switching frequencies and voltage peaks generated by VSDs.

VSDs use power transistors (typically IGBTs) for the switching process which occurs at high frequencies. To achieve the high switching frequencies, the transistors have to turn “On” and “Off” to conduct

Information provided by Zest WEG Group

current repeatedly at high speeds which results in voltage pulses with a high dV/dt (rate of voltage change over time).

When squirrel cage electric motors are fed by these high frequencies, the voltage pulses combined with the cable and motor impedances may cause repetitive conditions of over voltage or voltage overshoots at the motor connection terminals. This repetition of over voltage conditions may degrade the motor insulation system and result in a reduction of the motor’s useful lifetime.

The voltage overshoots affect the interturn isolation of the motor windings especially. The voltage overshoot level is affected primarily by the rise time of the voltage pulse, the cable length and type, minimum time between pulses and the switching frequency.

When standard electric motors are used with VSDs one should always confirm what voltage and frequency switching criteria should be met to protect the insulation system of the motor.

QUESTION FOUR

What is the purpose of insulation materials in electric motors?

ANSWER FOUR

The insulation material prevents, limits and directs the flow of electric current. Although the insulating material is primarily intended to insulate the winding conductor between the wire and ground or to the lowest potential, it also serves to provide mechanical support, protect the conductor from degradation caused by environmental influences and to transfer the heat to the external frame and environment.

Based on system requirements, gases, liquids and solid materials are used to insulate electric equipment. The Insulation system affects the quality of the equipment, and the type and quality of the insulation affects the cost, weight, performance and its useful lifetime.

A combination of two or more insulation materials applied to electric equipment is the designated insulation system. The combination of the insulation system on an electric motor comprises insulation of the conductor wire, the slot, the slot cover, phase to phase, varnish and/or impregnation resin, the connection leads and insulation of the terminal studs. Any material or component that is not in contact with the conductor is not considered part of the insulation system. **wn**

March

Movers, shakers and history makers

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

1 MARCH

1978 Comedian Charlie Chaplin's coffin was stolen from a small, unguarded village cemetery in Switzerland.

2 MARCH

1988 Ladysmith Black Mambazo became the first South African group to win a Grammy award.

3 MARCH

1971 The South African Broadcasting Corporation lifted its ban on playing of The Beatles' music.

4 MARCH

1956 An Wang sold his patent for magnetic core memory to IBM for \$500,000.

5 MARCH

1993 The Los Angeles Times reported that a blind student had made use of a talking Toshiba T1000 laptop computer to help him complete a bachelor's degree in political science at UCLA.

6 MARCH

1665 The first joint Secretary of the 'Royal Society of London for Improving Natural Knowledge', Henry Oldenburg, published the first issue of Philosophical Transactions of the Royal Society, the world's longest-running scientific journal.

7 MARCH

1997 For the first time, an internet entry won Bob Levey's Washington Post neologism contest. Contestants were challenged to create a new word to describe a negative reaction to Washington. Scott Burroughs' suggestion, *sqwashington*, was the winner.

8 MARCH

1955 Doug Ross, a computer pioneer, demonstrated the Director tape for MIT's Whirlwind machine. Instructions were 'fed into' to the Whirlwind using paper tape. The Whirlwind computer, the fastest digital computer of the time, was

four years old at the time, and was the first digital computer that could display real-time text and graphics on a video terminal. It did this using 4,500 vacuum tubes to process data.

9 MARCH

1959 Barbie, a fashion doll, made her debut at the American International Toy Fair in New York. Barbie has been the figurehead of a brand of Mattel dolls and accessories, including other family members and collectible dolls for over 50 years.

10 MARCH

1995 The financial Rand, which had been used as a parallel currency to the commercial Rand, was abolished on 10 March 1995. The currency was used in the 1980s and 1990s for the sale of non-South African residents' assets in the country and so was available only to foreigners and for investment in South Africa.



11 MARCH

1702 The Daily Courant, the first British daily newspaper, was published for the first time. It was produced by Elizabeth Mallet (a printer and bookseller) at her premises next to the King's Arms tavern at Fleet Bridge in London, England. The newspaper consisted of a single page, with advertisements on the reverse side.

12 MARCH

1989 Tim Berners-Lee submitted a relatively vague request for research funds, to CERN (the European Organization for Nuclear Research), to research a new way of linking and sharing information over the Internet. This system would ultimately become the World Wide Web.

13 MARCH

1986 Close to eleven years after Microsoft was founded, its stock went public at \$21 per share. The stock closed at \$27.75 a share having peaked at \$29.25 a share shortly after the opening. It is said that the rising value of Microsoft's stock made an estimated 4 billionaires and 12,000 millionaires of Microsoft employees.

14 MARCH

1955 AT&T Bell Laboratories announced the completion of the first fully transistorized computer, TRADIC (aka "Giant Brain"), which contained nearly 800 transistors, which replaced the standard vacuum tube and allowed the machine to operate on fewer than 100 watts.

15 MARCH

1985 The first internet domain name was registered as Symbolics.com. It belonged to Symbolics Inc., a computer systems company in Cambridge, Massachusetts, United States. Note - the first domain ever created was Nordu.net, which was never registered.

16 MARCH

1995 The world's first Wiki, WikiWikiWeb was created when Ward Cunningham invited people to add and edit content. A Wiki is a database that is a community collaboration. Cunningham said the inspiration for the name Wiki came from the Wiki Wiki Shuttle bus he learned of during a trip to Hawaii. Six years later, Wikipedia was launched, although Cunningham had no official involvement.

17 MARCH

1988 Apple Computer sued Microsoft for copyright infringement over the graphical user interface (GUI) of its operating system. After Apple developed the highly successful Macintosh GUI in 1984, Microsoft released their Windows operating system, which had some similarities in its GUI's look and feel. A judge eventually decided that Apple had only limited rights to the design.

18 MARCH

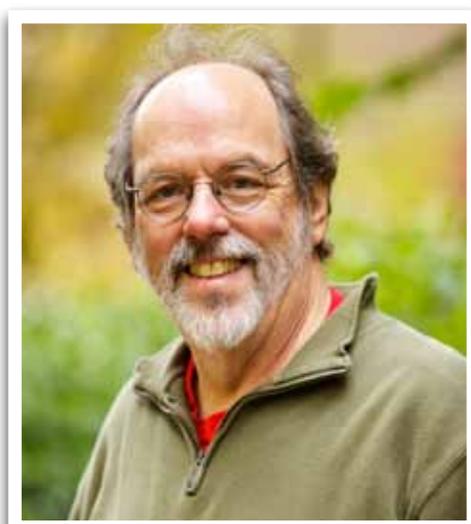
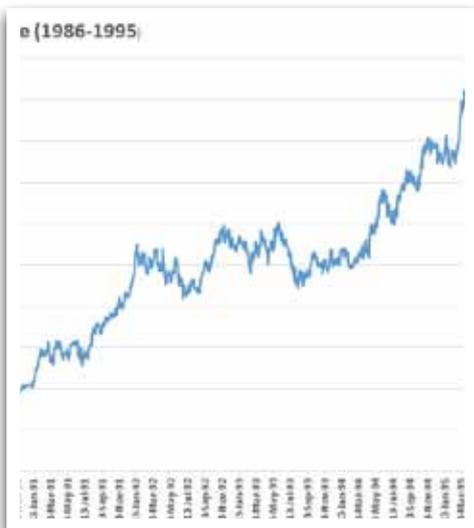
2010 According to the Guinness Book of World Records, **the longest nose on a living person** was measured at 8.8 cm from the bridge to the tip and belongs to Mehmet Özyürek (Turkey).

19 MARCH

1972 After a lengthy US legal battle John Vincent Atanasoff emerged as victor for the title of the inventor of the electronic digital computer. A judge determined his work had preceded and contributed to development of the ENIAC machine, whose inventors had previously been credited.

20 MARCH

1915 Albert Einstein published his general theory of relativity.



MARCH...

continues from page 63

21 MARCH

2006 The origins of, what is now known as, Twitter are the result of a brainstorming session at the podcasting company Odeo. The initial concept was to share short messages via SMS text messaging with a small group. Jack Dorsey, the primary designer of what was then code-named “twtr”, sent the first message at 9:50am on March 21st, 2006 - “just setting up my twtr.”

22 MARCH

1993 This was the first World Water Day. 2018’s theme is Nature for Water.

23 MARCH

2001 Russia’s space station, Mir, burnt up in the Earth’s atmosphere when re-entering after fifteen years in orbit. The debris that wasn’t burnt fell safely into the Pacific Ocean between Chile and New Zealand, in an area kept clear of planes and ships.

24 MARCH

1939 The film “Wuthering Heights” based on the novel by Emily Brontë, directed by William Wyler and starred Merle Oberon and Laurence Olivier, premiered in Los Angeles, USA.

25 MARCH

2016 Netflix acknowledged that they had been slowing their video transmission on wireless mobile carriers around the world for approximately five years to “protect consumers from exceeding mobile data caps.”

26 MARCH

1973 Women were allowed on the floor of the London Stock Exchange for the first time.

27 MARCH

1976 20-year-old Bill Gates gave the opening address at the First Annual World Altair Computer Convention in Albuquerque, New Mexico.

28 MARCH

2004 NASA’s hypersonic X-43A aircraft set a world speed record over the Pacific Ocean. Using a scramjet engine, the unpiloted, 3.657m aircraft achieved the speed Mach 6.83 -- almost seven times the speed of sound

29 MARCH

1989 Pixar won an Academy Award for Tin Toy. It was the first time an entirely computer-animated work won the best animated short film category. Pixar, now a division of Disney.

30 MARCH

1939 Batman made his first appearance to the world of comic readers when “Detective Comics #27” appeared on newsstands.

31 MARCH

2017 South African Charles Segal, the Grammy Award-winning pianist and producer, finished recording his 11,721st piano piece. **wn**





APRIL | MAY | JUNE 2018

APRIL 2018

3 - 5	2018 9th IEEE ICICS	Jordan	www.ieee.org
4-6	2018 3rd Biennial South African Biomedical Engineering Conference	Stellenbosch	www.ieee.org
4 - 6	2018 IEEE Green Technologies Conference (GreenTech)	Austin, Texas	www.ieee.org.za
9 - 10	IOT Standards and Applications	Johannesburg	roberto@saiee.org.za
9 - 10	2018 1st International Conference on Power, Energy and Smart Grid	Pakistan	www.ieee.org.za
9 - 13	ESKOM Cable System Course	Midrand, JHB	roberto@saiee.org.za
11 - 12	Advanced Microsoft Excel for Engineers	Johannesburg	roberto@saiee.org.za
11 - 12	Africa Investment Exchange: Gas	Cape Town	www.africa-energy.com
13 - 14	2018 Power Energy, Environment and Intelligent Control (PEEIC)	India	www.ieee.org.za
17	Road To ECSA Registration For Mature Candidates	Johannesburg	roberto@saiee.org.za
17 - 19	2018 IET 9th Power Electronics, Machines & Drives (PEMD)	Liverpool, UK	www.ieee.org.za
17 - 20	Managing Projects Efficiently	Johannesburg	roberto@saiee.org.za
18 - 19	Incident Investigation and Management	Johannesburg	roberto@saiee.org.za
24-25	Photovoltaic Solar Systems	Johannesburg	roberto@saiee.org.za

MAY 2018

6 - 9	2018 IEEE Rural Electric Power Conference (REPC)	Mephis, USA	www.ieee.org.za
9 - 10	Collaborative Teams In Engineering	Johannesburg	roberto@saiee.org.za
15 - 17	Africa Utility Week	Cape Town	www.african-utility-week.com
16 - 19	Planning Strategic Feasibility Studies	Johannesburg	roberto@saiee.org.za
20 - 24	IEEE ICC 2018	Kansas City, USA	www.icc2018.ieee-icc.org
22 - 23	Transformer Design, Protection, Testing And Maintenance	Johannesburg	roberto@saiee.org.za
22 - 25	2018 IEEE 22nd Workshop on Signal and Power Integrity (SPI)	Brest, France	www.ieee.org.za
24 - 25	High Voltage Testing And Measurement	Johannesburg	roberto@saiee.org.za
25 - 26	2018 Power, Energy, Signals and Automation	Chennai, India	www.ieee.org.za
29 - 30	Fundamentals of LTE Mobile Communications	Johannesburg	roberto@saiee.org.za
29	2018 Smart Grid and Clean Energy Technologies (ICSGCE)	Malaysia	www.ieee.org.za

JUNE 2018

3 - 7	2018 Power Modulator and High Voltage Conference (IPMHVC)	Wyoming, USA	www.ieee.org.za
10 - 15	2018 IEEE 45th Photovoltaic Specialists Conference (PVSC)	Hilton, USA	www.ieee.org.za
13 - 15	2018 IEEE Transportation Electrification Conference and Expo (ITEC)	California, USA	www.ieee.org.za
27 - 29	2018 15th Conference on the European Energy Market (EEM)	Lodz, Poland	www.ieee.org.za

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