wattnow

THE SAIEE CHALLENGE: THE WORLD IS CHANGING

DIGITAL

CONTENTS

SAIEE   @saiee

wattnow

abc

2018 Q2 - 15 811

This is the "Digital" issue, and in it, I have an issue jam-packed with great content.

Our first feature article "Gearing up for 5G" could transform architectural decisions across the industry. It has been touted as the new market enabler for many segments. However, it leaves the sceptics asking 'will it really live up to the standards?

The second feature article on page 18 - "6 Ways To Optimise Your Cloud Usage" - was written by Elaine Wang and provides some helpful tips for businesses looking to maximise their return on investment from the cloud.

Almost every primary product shipped nowadays includes embedded software and remote connectivity. With relying on someone else to update your software, is this not a nightmare waiting to happen? Read more on page 22.

Page 26 sports a survey the Service Desk Institute conducted during 2018 from businesses to find out if they really understand what "Digital Transformation" means.

Senior Member Johan Basson wrote a letter as a concerned SAIEE Member on the "Challenges Facing South African Panel Manufacturers" – read more on page 48.

Then, of course, the **watt**now will not be complete without an article from Dudley Basson, who wrote an investigative piece on the new International System of Units, which changed the world's definition of the kilogram, ampere, kelvin and mole forever. Find it on page 52.

This month, we celebrate my dear friend, and technical editor, Jane Buisson-Street's birthday. I want to take this opportunity to thank her for her diligent work in compiling the *"Looking Back"* article for the last 6 years – with the first one appearing in the April 2013 issue of **watt**now! Happy birthday Jane!

The SAIEE is hosting its Charity Golf Day in support of Ya Bana Village for Children on 24 April 2019. There are a few 4-ball spots available. Please contact Gerda (geyerg@saiee.org.za) to book yours for R3500.

Herewith the March issue – enjoy the read!

Minx

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

HELP UNLOCK OUR FULL POTENTIAL

A job shadowing workplace experience and a post-school alumni programme are the initiatives of a unique public-private partnership, conducted under the banner of TechnoGirl. As a significant contributor to the growth of Science, Technology, Engineering and Maths (STEM) skills in South Africa, we at TechnoGirl are convinced that well-developed STEM skills are vital to our country's future competitiveness in the global economy.

TechnoGirl would like to appeal to corporate South Africa to unlock the latent potential that exists in a primarily marginalised segment of our population – young women at the beginning of their productive lives with potential in STEM.

GET INVOLVED WITH OUR INITIATIVES

JOB SHADOWING
Starting at Grade 9 and continuing until the end of Grade 11, girls are given the opportunity to immerse themselves in actual work environments where
they are then able to observe, engage and generally experience the day-to-day rewards and challenges of specific technical job roles.
Shadowing sessions are scheduled over three consecutive school holidays, annually over the three years.

ALUMNI PROGRAMME
From Grade 12 onwards, girls join the Alumni Programme. This component supports them during their post-school education, access to industry networks and access job opportunities in their chosen field of study.

Contact us today to find out how you can make a difference!

TechnoGirl ZA   www.uweso.co.za   011 791 9950

TechnoGirl
Experience.Learn.Grow

INDUSTRYAFFAIRS

Nkgwete MD Siddika Osman Named 'Africa Tech Woman Of The Year'

Emalahleni-based Nkgwete IT Solution's Managing Director Siddika Osman was named 'Africa Tech Woman Of The Year' at Africa Tech Week's inaugural award ceremony in Cape Town recently.

Hosted by the City Of Cape Town and the Department of Science and Technology, Africa Tech Week promotes digital transformation by connecting government, corporates and talent from the tech industry and brought all parties together to talk technological disruption and the 4th Industrial Revolution.

Osman says, *"Nkgwete's IT vision is 'Unlocking Africa's potential through technology'. After spending two days at Africa Tech week, I can say with absolute certainty there is a phenomenal amount of potential in Africa and technology will be the key to unleashing this potential and moving Africa forward."*

Siddika Osman received the Africa Tech Woman of the Year Award for her visionary leadership and IT strategy at Nkgwete IT Solutions. Since the company's inception in 2012, Osman has expanded the team to 60 staff members and maintains a 41% female workforce.

To date, part of Osman's success has been her focus on creating significance. By creating jobs, mentoring people and empowering staff with technological tools and skills Osman has worked to develop a culture of relevance at Nkgwete.

With digital transformation the main theme of Africa Tech Week, Osman says that Nkwgete IT Solutions is ready to answer the President's call of Thuma Mina. *"I am humbled and very excited about winning The Africa Tech Woman of the year award. Special thanks to TopCo media for creating this platform and the South Africa UK Tech Hub for the sponsorship. Winning this award will enable me to do so much more for Tech in Africa,"* she says.

Enabling the Techtrepreneur™

SAIEE Past President, André Hoffmann (The Hoff) recently launched MyTechie South Africa. It is a privately-owned company established as a facilitator of standardised Information and Communication Technology (ICT) services to communities and ICT Service Providers.

MyTechie agents are brand-trusted 'village' technicians available to support the ICT industry in meeting the consumer need for supporting everything from fibre-to-the-home/business installations through to the full Internet of Things (IoT) ecosystem across its life-cycle from the private property boundary gate and in and around the smart home and property. Starting with basic fibre drop installations and progressing right through to the connected 'Smart Home.'

André is an ICT professional, having worked in the industry for over thirty-nine years. He has planned, built, operated and managed all tiers of the network while working for leading service providers in Southern Africa. For more information, visit www.mytechiesa.co.za

New DEHN Africa MD prepares to push new frontiers in lightning protection

The appointment of Hano Oelofse in October 2018 as the new Managing Director of lightning and surge protection specialist DEHN Africa, part of Germany-based DEHN + SÖHNE, is bound to move the company into new directions and geographical locations.

Having spent some five and a half years at DEHN Africa already, Oelofse has risen through the organisation's ranks, from Senior Technical Sales Engineer at the beginning of his tenure in 2013, to Technical Manager and then Technical Director, as well as taking on the position of interim MD from April to September 2018.

Oelofse, who is passionate about the science and art of lightning protection, is comfortable placing himself at the coalface of the engineering world. Having studied Electrical Engineering at the Central University of Technology, Free State, his early professional career included a stint at AngloGold Ashanti as well as time in Madagascar, where he worked on one of the largest nickel and cobalt plants in the world for an electrical company that provided full turnkey solutions.

He clarifies, *"In Madagascar, I was involved in the building of a limestone plant and a power generation plant, neither of which were yet operational. My duties involved the designing, installation and commissioning of the electrical reticulation system. It suited me to be hands-on and innovative from both an engineering design and installation perspective. The job required me to work in Madagascar for three months at a time, and then I was able to come home for ten days, which worked well for me, as I enjoy travelling and at the time did not have the family commitments that I do today."*

Having worked for the company for 18 months, Oelofse was invited to join DEHN Africa for its launch in South Africa in May 2013. *"My interest in lightning protection from an engineering and scientific perspective meant that this was a very positive career step for me. I couldn't turn down the opportunity to become involved with the opening up of the African subsidiary of a fourth-generation, 100-year-old international lightning protection company."*

"As with my previous job in Madagascar, the requirements of being involved in this new venture spoke to my entrepreneurial spirit and my interests in cultivating an international engineering perspective. At DEHN Africa, we are involved in working on many projects around the world, including within Indonesia, the Philippines, Singapore and Malaysia, while in Africa itself we've been involved in projects in Madagascar, Zambia, Kenya, Botswana and Namibia, besides South Africa itself, of course."

Oelofse is excited about DEHN Africa's planned trajectory during 2019 and beyond. *"The DEHN global plan for 2025 was released globally,"* he explains, *"and DEHN Germany has exciting initiatives and goals in the company's drive towards growth. At DEHN Africa we are looking forward to playing our part in the global vision.*

"One of my particular interests at work is my involvement in building and growing the DEHN Africa Engineering Services department, and the company overall. We have many exciting initiatives and focus areas within DEHN Africa at the moment, including the recent launch of DEHNinsure as well as our growing focus on the renewables area."

Away from work, Oelofse is a confessed fitness fanatic who runs half-marathons in his spare time, and also takes part in triathlons involving swimming, cycling and running. *"I like to run because it helps me to*

Hano Oelofse
Managing Director | Dehn Africa

focus, and I try to fit in races at the weekend. For me, running is like a metaphor for life, because if you keep on pushing and focusing, you will eventually get to where you want to be," he concludes.

INDUSTRYAFFAIRS

Sasol invests in Insikazi school district in Mpumalanga

From left: Nicky de Bruyn, Uplands Outreach; Ziyanda Makiwane, Sasol; Katia van der Merwe, Uplands Outreach; Beauty Mashego Mthambo, Uplands Outreach; Dean Somerset, Sasol; Joanne York and Violah Moyah Uplands Outreach.

Seven schools from the Insikazi School Circuit area in Mpumalanga benefited from a computer donation from Sasol Energy yesterday. This donation forms part of a Sasol Energy-funded digital literacy programme that educators from the circuit attended last year, overseen by the Uplands Outreach project.

The digital literacy programme consisted of lessons on computer hardware and software basics, emailing, internet usage, as well as Microsoft Office, including Word, Excel and PowerPoint.

"Building the capacity of teachers with practical ICT skills and equipment enables quality teaching and learning to take place in the classroom and, as such, equips the learners for a competitive and technological cutting edge world of work," said Dean Somerset, Manager: Marketing, Sponsorship and Social Investment at Sasol Energy. *"We are excited to work with Uplands in preparing learners and teachers for the digital age."*

This is the second year that Sasol Energy has worked with the Uplands Outreach project on this initiative. Uplands Outreach works closely with partner schools in the Insikazi School Circuit area with the aim of elevating educational achievements and making a sustainable impact.

"We are passionate about helping teachers to gain the confidence and the experience to use technology to streamline parts of their working lives," said Uplands Outreach Director, Dr Nicolette de Bruyn. *"We thank Sasol for partnering with us to fulfil this need. We are pleased with the level of commitment demonstrated by teachers and the 100% pass rate of all teachers who enrolled for the Digital Literacy courses."*

"The outreach programme is indicative of our commitment to education that seeks to promote people-centred, needs-driven and sustainable development of the communities in which we operate," concluded Somerset.

VSDs DRIVE COST SAVING IN PUMPING SYSTEMS

WEG Variable Speed Drives (VSD) offer the agricultural sector the ability to reduce the operating cost on automated water collection systems with a reduction in motor energy consumption when the motor speed is reduced.

In addition, the WEG Variable Speed Drive allows the monitoring of all functionalities of a pumping operation including special functions that will not only save operating costs but will optimise, control and protect the entire irrigation system.

Just as significant is the VSD ability to automatically send commands to the electric motor thereby facilitating optimum control of the pumping installation. This allows greater effectiveness when irrigating.

The WEG CFW 700 frequency inverter or VSD provides accurate speed variation for the electric motor ensuring it operates according to the irrigation system pressure needs (PID), and with the necessary field telemetry it can also take different land inclinations into account.

Another important benefit is the WEG VSD's ability to detect low pressure indicating leakage in a pipeline. With this early warning from the WEG VSD, end-users can eliminate the need for specialised equipment and be able to take remedial action as soon as possible.

Where water is being pumped from a river to the dam for further irrigation, use of the WEG VSD will allow optimum control of the water level. It will prevent overflow situations, and dry pumping can be set up without the addition of flow sensors.

The WEG VSD can be used to facilitate sleep and wake modes in the pump operation. This facilitates significant cost savings as pumping can then be done on a demand driven basis only.

African Artificial Intelligence Pioneer Awarded AI Leader Of The Year

South African based Artificial Intelligence Software & Solutions veteran and founder of Cortex Logic, awarded premium accolade at Africa's Tech Week event, underlying a life dedicated to AI and Data Science Innovation.

Dr Ludik is an African based smart technology entrepreneur and Artificial Intelligence investor / AI ecosystem builder, holds a PhD in Computer Science and has amassed 25+ years' experience in the study and exploitation of AI & Data Science in real world applications. Ludik was formally a founder of Bennit AI, Mosaic, SynerG and CSense Systems, the latter being Africa's first AI company sold to General Electric in 2011. Over his career Jacques has published a wide range of papers on AI, Advanced Analytics, Machine Learning and Data Science and is a big supporter of AI for social good. He is currently Founder & CEO of Cortex Logic and Founder & President of the Machine Intelligence Institute of Africa (MIIA).

Dr Jacques Ludik said, *"It's such an honor to receive any award and this one is special because it comes at a time when AI is moving beyond the hype and into the realm of real world application both in the Enterprise and society in general."*

Ludik went on to say, *"My current focus is two-fold; at Cortex Logic we are now building a series of products and platforms embracing all aspects of Artificial Intelligence to help businesses solve complex business problems using the power of machine learning, deep learning, Internet of Things (IoT) and Big Data & Analytics. At the Machine Intelligence Institute of Africa we are building a community that aims to leverage AI for social good, education and transformative change in wider African society. It's been a passion of mine for many years and there has never been a better time for young engineers, entrepreneurs, business & governments to begin their journey into the 4th Industrial Revolution."*

Ludik concluded, *"Every sector of society and commerce will be impacted by AI and I cannot wait to see what the future holds. However, we have some key challenges to solve around the ethics and impact AI will have on society so it's imperative that we all begin to focus on this debate and how this smart technology era will be leveraged for positive change, growth and benefit for all. I look forward to the next 25 years of change and will continue to focus on the positive impact this could have not only in Africa but the entire world."*

Where there are multiple pumps in use at the same pump station, it is possible using WEG Pump Genius Software and the WEG CFW11 VSD to automatically alternate motor usage to ensure that each motor/pump combination has equal operation time. This will avoid one pump being subjected to excessive wear and regulate the wear across all the pumps resulting in the lowest total cost of ownership for the installation.

Optimisation of water in the agribusiness undoubtedly improves product quality and production between harvests and allows optimum use of land, and WEG VSDs will assist in achieving this.

How beneficial are local cloud data centres for SA business?

Cloud technology has become synonymous with business operations, affording business greater scalability and flexibility cloud computing has fundamentally changed storage and mobile enterprise processes. This is further seen in the recent building of could data centers by Microsoft, Amazon and Huawei in South Africa. However, this increased drive towards cloud data centers begs the question, what does South African business - small business in particular have to gain by investing in cloud computing, especially with POPI coming into play and mobile enterprise technology leading the journey towards to operational efficiency?

BY I ELAINE WANG
DIRECTOR
RECTRON CLOUD AND
SOFTWARE SOLUTIONS

DATA CENTRE ORIGINS

Data centres have initially always been something a company keeps on-premises. Physical infrastructure which stores the critical data needed for the business to continue operations. However, data centres need to evolve along with the changes in expectations of both consumers and companies for "always on" systems.

On-premises servers are still seeing growth, and depending on their unique needs, it might even be the best option for a business. However, cloud data centres will be especially advantageous for small and medium-sized enterprises as not all companies have or can afford to have, the secure server rooms needed for on-premises data centres.

OPERATIONAL BENEFITS

Cloud data centres bring flexibility to a network by removing the complexities of different infrastructure created for a specific application. By standardising the data centre to work within any environment and in any industry, cloud data centres can reduce the costs of updating or replacing legacy software, increase efficiencies and reduce latencies.

Overcoming latency issues is extremely important for businesses as it is an ample reason why some applications cannot be moved to the cloud. Load shedding is also a unique challenge that companies in South Africa face, as blackouts can cause on-premises data centres to lose data, which can be extremely costly. Use of enterprise-level cloud data centres can eliminate the possibility of data loss as a result of a sudden loss of electricity.

LEGISLATION CONCERNS

Another benefit to having local cloud data centres in South Africa is the peace of mind it provides around the Protection of Personal Information Act – which requires that data be stored within the borders of the country – while providing businesses with enterprise-grade security, capability and reliability. As these data centres would

be compliant and complementary to POPI, government, government agencies and municipalities, and the financial sector will feel much more comfortable with storing their data on the cloud, but still within the country.

SECURITY

A cloud data centre is critical infrastructure for cloud computing, and as cloud computing, there are still some concerns as to its safety. However, cloud data centre infrastructure is secure as long as it is in the Trusted Cloud.

While there has been an increase in attempts to hack cloud infrastructure, there are still many cloud services, like Microsoft's Azure, which has never been hacked. The vulnerabilities in a cloud data centre mainly lie in the user, those managing and accessing it, due to the checks and balances the data centre employs.

DEVICES

Devices play a big part in the modern workplace as they are the core of a business, enabling employees to work from anywhere and integrating new functionalities naturally and seamlessly.

In the office of the future, the way that work is carried out will be adapted to the user and not the other way around. However, as devices are in the hands of employees – who are usually the weakest point in a network – businesses need to make sure they are secure, especially as they will be the access point to the critical data stored in the data centre.

In short, having local cloud data centres in South Africa can only serve to help businesses increase their efficiency and productivity while saving on costs – a big plus in the context of the current local economy. These data centres will allow organisations to improve their business operations and move away from legacy infrastructure, which will drive innovation and ease scalability. With the cloud, the future of South Africa is bright. **wn**

Uninterrupted Power Supply protect homes and businesses during loadshedding

Loadshedding is becoming a daily reality in South Africa, and is not only affecting businesses and essential services, but all of us in our homes.

Riaan de Leeuw, VP for IT Division - Anglophone Africa at Schneider Electric, says it is therefore crucial to protect our homes and businesses against sudden loss of power or surges.

"This is particularly true of small to medium-sized businesses, who are more at risk due to their limited ability to maintain security and generate revenue during downtime," he explains.

"And while many people are turning to generators to get them through loadshedding, soaring petrol prices mean this is an expensive and not very eco-friendly way to go. However, for both homes and businesses, an Uninterrupted Power Supply (UPS) can protect businesses against downtime," he adds.

Uninterrupted Power Supply solutions protect and save the electronic equipment we rely on so heavily, and are scalable according to different needs, says de Leeuw.

For example, a Uninterrupted Power Supply for basic home use, will allow a WiFi router to run, cell phone chargers to operate, and the safe shut down of a single PC, below 500watts.

"For advanced home, or basic small office use, there are solutions that will enable a TV and or decoder or game console and surround sound to run. Users would also be able to keep the lights on, if connected to the DB board, and are between 1000 and 3000 watts. In this instance, runtime would be dependent on additional external batteries and physical load."

For a basic small or home office, there are solutions that will allow between one and five PCs to run, with monitors and the

router or switch to allow connectivity. He adds that it is advisable to connect printers to an Uninterrupted Power Supply due to power spike during start-up. *"Again, users could run between 1000 and 5000 watts, depending on extra batteries and the physical load."*

There are also solutions to cover advanced small to medium use, which would include one to 20 PCs with monitors, the server, router or switch, and lights if connected to the DB board. *"While you would have between 5000 and 20000 watts, the same rules apply in terms of batteries and load."*

According to him, Uninterrupted Power Supply offers guaranteed power protection for connected electronics, which ensures businesses can keep their doors open and maintain contact with partners and customers. *"Remember, keeping Wi-Fi up and running rather than having to rely on cellular data during load shedding gives you a better chance of staying online, for longer."*

"Should power be interrupted, or fluctuate outside safe levels, an Uninterrupted Power Supply instantly provides clean battery backup power and surge protection for sensitive equipment, giving enough time to safely power down non-essential devices and keep critical business operations up and running. It will also provide battery backup power and protection for equipment such as TVs security systems, gaming consoles and mobile devices."

"When selecting the right Uninterrupted Power Supply solution for your needs, consider that a Uninterrupted Power Supply should have an output watt capacity 20-25% higher than the total power drawn by any attached equipment," cautions de Leeuw. *"Moreover, runtime is important, giving an indication as to how long an Uninterrupted Power Supply will be able to power its attached equipment in the event of a power disruption."*

Lastly, he advises to test all equipment by unplugging the Uninterrupted Power Supply periodically to make sure all attached equipment stays powered. **wn**

Gearing Up For 5G

This new communications standard could transform architectural decisions across the industry, but not right away and not necessarily in distinct ways.

5G has been touted as the new enabler for many market segments, including mobile phones, automotive, virtual reality, and IoT. However, there are many questions and much speculation about when and how this new wireless standard will impact different market segments and what effect it will have on semiconductor design.

BY BRIAN BAILEY

With a promise of orders of magnitude improvement in communication speed and low latency, systems vendors will need to decide between whether to process data locally or in the cloud and how much should be done where. That will have a significant impact on semiconductor architectures, from processor and memory choices to on-chip throughput, I/O speeds, power budgets and even battery sizes. Besides, those decisions will be affected by access to 5G infrastructure and frequency of communication.

It could be years before any of this happens, in any case. Initially, much of the 5G rollout will be in the sub-6GHz range, which was compared to 4.5G. The biggest beneficiary will be the mobile phone industry, which will remain the largest consumer of the technology for some time. Phones will continue to define standards and drive volume, and they will remain the largest source of funding for this technology.

It's the next phase of development, when millimetre-wave technology is introduced, where the most significant changes begin to occur. The general rule of thumb is that for any new technology to be successful it has to provide a 10X gain, which can be in the form of performance, power reduction, reduced cost, smaller area or a combination of many attributes. It's here that 5G will begin to shine.

"5G will provide significant improvements in connectivity and is targeting 1,000X performance over what 4G achieves today," says Steven Woo, vice president for Systems and Solutions and distinguished inventor at Rambus Labs. *"In addition to improved bandwidth, 5G promises lower latency and better coverage as well."*

In the early days of mmWave, design costs and silicon area will go up significantly. Moreover, power consumption will be

a significant concern, depending on infrastructure and load—where signals are being sent and what computing is being done once those signals arrive.

IMPACT ON IoT

One area that could benefit from 5G is edge computing, where power is a limiting factor.

"We'd expect IoT edge devices to use less energy with 5G because the access points will be closer on average," says Neil Robinson, product marketing director at Cadence. *"This means less power required during communications compared to greater distances required for 4G."*

This opens the door for more complex processing and communication schemes that are available today. *"5G will provide higher bandwidth, which means that the growing number of connected endpoints will have an easier time communicating their data to neighbouring locations where the data can* be processed locally," says Woo. *"This means that only higher-level information, and/or the data itself, optionally being transmitted on to cloud data centres."*

However, this kind of scheme also can get complicated very quickly. *"The significantly higher bandwidth and multiple antenna strategies required for 5G mean that by their very nature they are more power-intensive,"* points out Jean-Marie Brunet, senior director of marketing for the Emulation

Gearing up for 5G

Division of Mentor, a Siemens Business. *"However, there is broad agreement that the majority of IoT will be machine-to-machine (M2M) communications. It's arguable that M2M communication patterns will be more predictable than human-initiated IoT, and therefore low-power algorithms for M2M instances should be much more efficient."*

Actual benefits will vary by application and by region. *"The bottom line is that 5G provides a 10X to 100X reduction in power per bit with a commensurate 10X bandwidth bump, which could yield a net gain in power longevity and a 10X improvement in power efficiency. This most likely will vary depending on the use modes employed."*

Will that be enough to impact architectures? IoT edge devices had started to incorporate inferencing locally to avoid bandwidth impacts associated with transmitting large volumes of raw data to the cloud.

"Higher bandwidth and lower latency will make it easier to do inferencing in the cloud if that is what is needed and/or appropriate," says Cadence's Robinson. *"However, privacy, security, latency and power concerns may make it inappropriate."*

Lazaar Louis, senior director of product management and marketing for Tensilica IP at Cadence, echoes those concerns. *"Scenarios that have privacy and security concerns will continue to run inferencing at the edge,"* he says. *"Communicating the sensor information to the cloud consumes energy, and hence there will be savings in energy consumed at the edge by performing inferencing at the edge."*

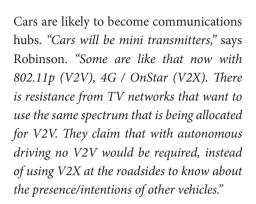Rambus Labs' Woo agrees. *"Higher bandwidths likely won't eliminate the need*

for inferencing at the endpoints, but they will allow a much larger number of IoT devices to be interconnected, enabling infrastructure to keep up with the ever-growing demand for more Internet-enabled devices, and for the growing amounts of digital data they capture and communicate."*

VR AND AR

Virtual reality has hit a roadblock. Without higher data rates, vendors are having difficulty eliminating motion sickness, and that is limiting adoption. Millimeter-wave technology could help solve that. While mmWave signals cannot go through walls and only operate over relatively short distances, VR headsets typically are just feet away from a controller. *"A high-resolution, 8K game streaming activity will certainly kill the battery sooner compared with a previous 4G generation product running the same game,"* admits Brunet. *"But this is not so much because of 5G. It's because of the advanced CPU and display characteristics. At mmWave frequencies, there's an accelerating effect on power efficiencies on transceivers for over-the-air (OTA) power requirements."*

AUTOMOTIVE

Autonomous driving requires many technologies coming together, and 5G is one of them. *"Lower latencies bring benefits for connected vehicles with autonomous driving capabilities, where response times are critical, especially at highway speeds,"* says Woo. *"Improved coverage will be coupled with more local processing capabilities that will allow data to be aggregated and processed closer to the endpoints where it's generated, reducing data movement. Reducing data movement over long distances is a critical benefit for 5G as it improves both latency and power consumption."*

Cars are likely to become communications hubs. *"Cars will be mini transmitters,"* says Robinson. *"Some are like that now with 802.11p (V2V), 4G / OnStar (V2X). There is resistance from TV networks that want to use the same spectrum that is being allocated for V2V. They claim that with autonomous driving no V2V would be required, instead of using V2X at the roadsides to know about the presence/intentions of other vehicles."*

Others agree. *"Vehicle to Everything (V2X) will dominate communications, and vehicles will become mobile networks that have many transmitters—in many cases more than one transmitter per functional domain,"* says Brunet. *"V2X will be a key enabler for safety where LiDAR or RADAR simply can't see around corners, and where the diversity in 5G depends on reflections around a corner to operate."*

Whether they get that information from other cars or roadside information isn't clear yet. *"Cars will make better decisions on autonomous driving experiences the more information they have available to them,"* notes Cadence's Louis. *"Advanced levels of autonomy will benefit from V2X communication from other vehicles or infrastructure. Examples include path planning and lane change assistance."*

New communications abilities also will create possibilities not fully considered today. *"Connected vehicles are just one of many types of devices that are likely to benefit,"* says Woo. *"The higher bandwidths and improved coverage coupled with more local processing will help vehicles communicate with their surroundings, as well as with local map data, to navigate roadways in the future. Today's connected automobiles already capture large amounts*

of data, and some of this information is transmitted into the cloud. Cars are expected to continue evolving into information hubs, as they can serve as connection points for passenger devices (much like mobile phones serve as connection points for peripherals like smartwatches and fitness devices), as well as perform peer-to-peer communication with other vehicles to communicate intended actions like lane changes, traffic conditions, and hazard information."

IMPLEMENTATION CONSIDERATIONS

Most 5G implementations today are prototypes, and not all of the implications have been sorted out yet. For example, 5G can operate between 10 and 20 Gigabits per second, but the digital system has to be capable of operating at this rate to take advantage of those speeds. That could restrict the technology nodes that can be used or require advanced packaging solutions if digital content is manufactured at an older node to reduce costs.

"It is a combination of Moore's Law slowing down and also the increased complexity of the chips and the processing required," says Frank Ferro, senior director for product management at Rambus. *"Instead of doing one large ASIC, you have to ask if it is more cost-effective to disaggregate it. Is it cheaper to do two smaller ASICs or to re-use the mixed-signal content in which you have made much investment? If you have made that investment in high-speed process technology, do you want to keep scaling that? Alternatively, can you use the existing technologies, plus an interface technology, and not have to develop the SerDes every time you change process node?"*

Again, different product domains may reach different conclusions. *"There's no 5G*

node expectation that I am aware of,"* says Robinson. *"It will come down to a cost evaluation for each product or company. The biggest restrictions come when the analogue needs to be integrated with the digital in some way. This may be driven by end-product size, cost and power limitations. IoT edge devices are extreme, where high integration is key. They are also likely to be using an older-node technology to keep costs down, as the performance requirements are typically low. V2X, user equipment and infrastructure typically have separate chips due to the larger sizes and prices."*

There are downstream effects when considering standards. *"Everything is driven from the bandwidth requirements or data requirements,"* says Sunil Bhardwaj, senior director for Rambus' India design centre. *"There is a demand to make faster systems, and this is both for the processing, which is heavily supported by the digital domain, as well as how fast the chips can get the data out to other chips and systems. This is why the standards are evolving, and those requirements by necessity are driving the constraints around both the digital and analogue side to speed up. It is challenging to support some modern standards using older process nodes. You cannot achieve the data rates by using the digital technologies of yesterday. Technology scaling supports these downstream effects."*

There is much complex processing required for 5G. *"By transferring complexity to the digital side and allowing imperfect raw analogue characteristics, it is possible to reduce the area and power for the block significantly,"* says Manuel Mota, product marketing manager at Synopsys. *"The ability to scale analogue blocks, such as very-high-speed data converters and antenna*

arrays, to small areas is a key-enabler driving new market segments such as 5G communications. Multi-GHz operation and signal bandwidth were previously only accessible using external, high-power chips, which were incompatible with the requirement for small form factor and low power associated with battery-powered and handheld devices."*

CONCLUSION

Much remains unknown about 5G and the impact it will have on a variety of markets.

What is clear is that it has the potential to cause architectures to be reconsidered, and for entirely new application domains to be discovered that were not possible in the past. However, much expensive work has to be done at the infrastructure level and in the mobile phone industry before much of this technology will be suitable for other domains.

Mobile phones are expensive items that consumers continue to buy and are supported by services being added on top of the business model. At this point, no other market is a prominent driver of this technology. The automobile industry may be able to support those costs, but the volumes are a fraction of those in the mobile phone industry. Moreover, there is no clear business model to have autonomous vehicles pay for the infrastructure and data that would make them possible. So IoT edge nodes are low cost, and the entire investment will have to be justified by the services offered.

At least in the beginning, this will be mostly about phones. However, the really big shifts will extend well beyond what fits in your pocket. **wn**

6 ways to optimise your cloud usage

For the longest time, companies have been involved in discussions around the benefits of shifting their data and applications to the cloud. However, it's increasingly apparent that the time for those conversations is over.

According to the Cloud Africa 2018 report, usage of the Cloud among medium and large organisations in Africa has more than doubled from fewer than 50% in 2013 to pervasive use in 2018.

BY ELAINE WANG
CLOUD AND SOFTWARE SOLUTIONS
DIRECTOR **I** RECTRON

Findings from the report were clear – the conversation is no longer about whether to use the cloud, but rather how businesses are gaining benefits from the cloud.

However, though the benefits of cloud are now widely recognised, they are still not prioritised.

It begs the question – how can companies start to prioritise, and therefore, optimise their cloud usage?

SET THE RIGHT GOALS

A robust cloud strategy begins with an understanding of the core business goals that need to be achieved. The company is then able to consider the tools it can leverage to achieve these goals.

Elaine Wang, Cloud and Software Solutions Director at Rectron provides some helpful tips for businesses looking to maximise their return on investment from the cloud.

The conversation on business goals needs to take into consideration many different objectives, including how to maximise operational productivity; how to engage with and delight customers, as well as how to minimise downtime. All of this is underpinned by an expectation that business environments need to operate securely and in a compliant manner.

By identifying the goals, the business can start engaging with consultants that can advise on a variety of tools to achieve these goals, assisting them to set short, medium, and long-term plans. At this point, businesses should also weigh up the benefits of using cloud applications versus traditional on-premise hosting.

Understanding what cloud means to your business is very important. A recent study shows that companies that are easily able to articulate the value of the cloud to their companies see a higher return on investment from the cloud. These businesses typically see a 51% increase in top-line revenue originating from the cloud.

INTRODUCE ACCOUNTABILITY

Once you have the right goals in place, appoint someone to be responsible for your cloud strategy. Ideally, this should be someone who has not only a firm handle on technology but also someone who has a deep understanding of your business.

Cloud usage

This individual can then monitor the business' progress, mapping it against your original cloud goals. Never underestimate the importance of keeping your business accountable to its original objectives.

After that, identify the individuals responsible for the technical delivery. This typically involves someone from the IT department in the organisation, but should also include external service providers.

DATA RESIDENCY CONSIDERATIONS

With local legislation such as the Protection of Personal Information Act dictating how data should be managed and stored within an organisation, many businesses do not feel comfortable storing their business outside of South Africa. As such, considerations around where the data is stored will have an impact on the solution the business ultimately chooses to implement.

CONSIDER CLOUD-NATIVE APPLICATIONS

At a basic level, cloud services can be broken down into two primary functions, storage and compute. To make sure that your company can benefit from computing as well as storage, your applications should be cloud-native – this refers to how the applications are created and deployed rather than where they are stored.

Through Microsoft Azure, for example, cloud-native applications can be built from the ground up – ultimately optimising them for cloud scale and performance.

Moreover, when you store your data in a cloud-native format, you open up your business to a whole host of benefits, including Data Recovery and analytics.

It's also worth noting that if your business makes use of modern cloud-based applications, they can communicate with one another. This means that your businesses can have key applications talk to one another to generate valuable insights and develop better products and services for your customers.

CALCULATE THE COST OF DOWNTIME

Another critical question revolves around the level of security your business requires.

It's critical to ask yourself how much downtime would be acceptable for a particular application. Once you establish the cost to your business of that downtime, you will then have a clearer idea of how much to invest in making the application highly available.

In addition to the uptime guarantees that reputable cloud vendors offer, one also needs to consider the obvious – what happens if the physical infrastructure at the office fails? Think, for example, of the increasing possibility of power cuts and loss of Internet connectivity.

Cloud providers like Microsoft offer a range of different security controls, and it's also useful to know that opting for a Disaster Recovery Plan can help make your information even more secure. Should the worst happen, all your data will be safely backed-up.

CONSOLIDATION OF TOOLS

It can be challenging to navigate the plethora of tools available in the market and businesses need to consider how the options they select will be used and managed within the organisation.

From a user perspective, it might make more sense to log onto one central portal, using single sign-on rather than having to log in to multiple different portals. From an administrative point of view, it may also be easier to manage tools when they are consolidated from a central portal that monitors all services, rather than having to maintain multiple disparate systems.

Finally, businesses should also determine the types of files their organisation needs to store, accurately assessing each of these items' storage requirements. In this way they can ensure the capacity they purchase directly correlates to the organisation's needs, ultimately helping the business to avoid unnecessary costs.

By walking through a few of these basics principles, your business can genuinely start to optimise its cloud usage.

This ultimately will lead to higher returns for your company and a robust platform from which you can continue introducing innovation to your business. wn

The hidden costs of buying cheap

Penalties, reputational damage and system failure can rack up massive costs on a sub-standard power installation, warns Tank Industries.

BY CLIVE MAASCH, GENERAL MANAGER AT TANK INDUSTRIES

There is an Afrikaans saying: *'Goedkoop is duur koop'*, which, translates to 'buying cheap is buying expensive'. This is particularly relevant in the power sector, we're getting it wrong by using inferior products, and unreliable suppliers can incur massive additional costs.

As sub-Saharan Africa races to address the power deficit, we will see a growing number of power facilities being rolled out across the region. As with any sector boom, a wave of suppliers will enter the market looking to cash in on the growth. Some of them will be fly-by-night companies offering inferior products at bargain basement prices.

Contractors and installers looking to boost their margins should view these suppliers with caution, however. On the face of it, cutting the cost of cable and accessories may appear to be an excellent way to reduce the project costs and win the tender. But in the long term, there are hidden costs associated with partnering with untrusted suppliers.

For example, should a supplier lack nationwide technical support resources, an installer might lose days on the installation while awaiting technical back-up from the vendor. If the supplier has insufficient cable and accessories in stock, installation could be delayed for weeks pending an order from overseas.

These delays can impact on the switch-on deadline and cause the contractor to incur high penalties.

If the cables and accessories are sub-standard, systems failures a year or two down the line impact the contractor's reputation, the utility's service delivery and the end customer's experience — all of which result in additional costs.

Should the supplier be unable to supply product training for staff, the contractor, utility and local authorities could suffer costly delays and future downtime due to faulty installation.

The most cost-effective power installation is the one that rolls out efficiently, on time, and operates reliably for at least the next 15 years. Achieving this depends on a combination of industry-leading cables and accessories and a supplier who does more than drop off products, but instead actively partners with the contractor in ensuring a successful roll-out.

Tank Industries, the market leader in low and medium voltage cable accessories, has a 25-year track record of supplying the South African power sector with TE Connectivity's industry-leading Raychem products. Owned by CBI African Cables and part of the JSE-listed Reunert Group, Tank Industries fields the best niche technical skills and training available in South Africa and supports contractors nationwide with its expert professional support team and multi-million rand in-country stockholdings.

Updating your safety-critical product

- a nightmare in waiting?

Almost every primary product shipped nowadays, from home networking routers and refrigerators, to medical equipment, the automobile, to the latest commercial aircraft, includes embedded software and remote connectivity. In most cases, the software inside these products can be updated in the field remotely; either automatically via the Internet, on-demand by the end user, or via a factory service centre.

BY PETE DECHER

Modern connectivity (when combined with an embedded software update capability) allows software developers to fix software bugs even after the product has shipped. However, this also creates some new challenges in terms of increased expectations that the end product will be maintained for a much more extended period.

WHAT ABOUT SAFETY-CRITICAL APPLICATIONS?

For embedded systems in safety-critical applications, requirements for very long product support life have been in place for numerous years. Commercial passenger aircraft have an average life of 30 years. The average life of a new passenger vehicle is about eight years.

To make matters worse, most developers have trouble remembering all the details of the software they worked on just six months ago. Imagine the challenges associated with having to fix a critical issue in embedded code that is many years old. Fortunately, today's state-of-the-art software development practices mandate the archiving of the software source code, as well as compilers and libraries, once the

UPDATE

LOADING...

manufacturing release milestone has been reached.

Following best practices certainly helps to reduce the risk of a product software update disaster in the future. Unfortunately, it does not eliminate it. This is especially important for embedded software for safety-critical applications. Safety-critical certifications, such as DO178C (Software Considerations in Airborne Systems and Equipment Certification) review the software requirements traceability, along with the software design and verification processes, to ensure they meet the certification objectives. There is no formal long-term proof of product maintainability requirement that needs to be matched to achieve product safety certification. However, everyone agrees that long-term product maintainability is necessary and hopes that the discipline required to obtain certification will reduce the risk associated with long-term product support.

Updating your safety-critical product

However, hope is not a plan.

As an experienced project manager, you plan and execute carefully to avoid future disaster. You archive your entire source tree (which you've meticulously maintained under source control) including source code, makefiles, toolchain, and test suites. You verify that you can reproduce the exact binaries that were released to manufacturing, even going so far as to build the binaries "off network". You have stored copies offsite as part of a disaster recovery plan. You have done everything you can think of to ensure reproducibility, so you have nothing to worry about. You can sleep well at night.

Or can you?

CHANGING REQUIREMENTS

It is an unfortunate fact of life that the only constant is change. Things will change in your product space. New legal requirements will be imposed, possibly forcing new code development. Critical vulnerabilities may be uncovered in your product, requiring software patches to protect your customers. Also, products have been known to exhibit bugs when exposed to a broad customer market. The reality of product life cycles is that you are at some point almost certainly going to have to update, rebuild, and deploy your product software.

Given your careful preparations, most of the time this will not be a problem. However, in the case when it does become a problem, it can be a huge one with expensive ramifications.

SOFTWARE IS COMPLEX

No matter how well you investigate, prototype, and plan, surprises happen.

Also, surprises are rarely useful in the software realm.

Because of software's complexity, software changes often have unexpected consequences. With any software change, there is some probability that it will help things overall as well as a (hopefully small) possibility that it will break something. The unfortunate reality is that it only takes one principal defect to break the product. The more changes you make, the higher the probability that you will break your software build.

This is particularly true with compiler toolchains. Compilers are incredibly sophisticated tools centred at the core of building your software. Given their sophistication and complexity, it is impossible to guarantee that a change to a compiler toolchain has no unintended side effects. Moreover, "side effects" in this case doesn't just include bugs; it also includes just changing things that your software implicitly depends on.

Your exact nightmare scenario – the one you haven't planned for – occurs when you have to update your toolchain, you build your product, you boot it, and you get:

SEGMENTATION FAULT
(core dumped)

What to do?
Your updated software no longer runs. The original development team has scattered to the wind. Even if you can find them, it's been years since they've developed the program, and it has long faded from their memory. You've got a runtime error – the absolute hardest to track down, because you have to know how the software is supposed to work

even to start, and no one (even the original developers) remembers how the software is supposed to work.

These situations do happen. As an illustration, here are four real-world examples:

1. By pure randomness, an integer element of a structure ended upon a doubleword aligned address – an implicit requirement of the underlying hardware. Nothing in C or the code caused the integer to be doubleword aligned; it just happened. The updated compiler optimised some variables away, changing the memory layout so that the structure element was misaligned, causing a segmentation fault. Understanding the problem and discussions with the compiler vendor establishing that it was not a compiler bug, delayed a product update by six weeks before the company corrected the alignment using a union.

2. An application forgot to initialise a variable to zero, but because it was always allocated to the same stack location, it ended up being zero anyway. A compiler update moved the variable to a different location, which was not zero, and which caused random results out of the application. Tracking back the wrong conclusion to its source and correcting the application delayed shipment by two months.

3. An application incorporated new libraries and picked up a new version of semaphores that was incompatible with the previous version. Due to an undiscovered bug in the product build, both versions were incorporated and used in the application causing random semaphore failures which created incorrect results. Tracking back from the false results to the

semaphore incompatibility to the build inconsistency delayed product shipment by six months and cost over $100k in consultant time in addition to the developers' time.

4. An application that was developed under a compiler that had a known problem of generating incorrect branch code for "long branches" was carefully tailored to avoid triggering the bug – all branches were ensured to be short. However, the updated compiler implemented loop unrolling, causing the branches to hit the compiler bug. When the compiler generated the incorrect code, the code jumped to a random location, which would then continue for quite a while before either triggering a core dump or inaccurate results. Tracking down the problem and disabling the unrolling option delayed shipment by two weeks.

These outcomes do not lead to sleepful nights for project managers. There is no good way out of these problems. The key to restful sleep is not getting into them.

MINIMISING CHANGE

Given the probability of hitting a problem arises from the likelihood of hitting an update that breaks things, the apparent avoidance is to reduce changes to the toolchain. The ideal case is never to change the toolchain, and that is the model most program managers strive for. Unfortunately, guaranteeing no change is a hope, not a plan. Between legal requirements, CVEs, bugs, and desired new features relying on no toolchain change are not feasible.

The problem is further exacerbated by compiler releases and the frequency of compiler fixes. Compiler patches are applied sequentially, in the order in which

they are found and fixed. As a result, to patch a just-fixed CVE in your five-year-old compiler, you can't just apply the CVE fix. You have to reapply every fix that has been used to that compiler in the past five years. That is not a small number, and that is not an approach that minimises changes.

The problem is even worse when your product is safety certified. Anyone who has taken a software product through a safety-certification process is well aware of the pain and cost involved. A re-released product has to be recertified. If you have to take your revised product through the entire certification process, you are looking at another year delay in release beyond the delay resulting from any problems, you've encountered.

HOW DO YOU AVOID THESE NIGHTMARE SCENARIOS?

The problem is obvious: you want to minimise the number of changes to your toolchain, and normal toolchain development does not support that. You can either hope that you never need to update your toolchain or you can plan to avoid the nightmare scenario when you do. That plan is frozen branch toolchain support.

With a frozen branch toolchain support, you apply only the updates you request to your toolchain. To get the fix for a CVE you need, you only get that CVE; you do not get all the changes that have been applied to that toolchain over the past five years. As a result, you get the minimal number of changes to your toolchain; you have the lowest probability of a nightmare build problem; and if you have to recertify, you can quickly point to the correct changes made in your toolchain. This has a lot better chance of simple recertification than

a random collection of changes aggregated over a long period. This approach minimises the overall changes to the toolchain, and thus, the risk of introducing any new issues into the product along with your intended fix. Also, a detailed report covering all the changes made to the toolchain should be available to ease the safety critical certification review. **wn**

Many service desks are undertaking projects in preparation for implementing Digital Transformation. Understanding what stages service desks are currently at, the involvement of the business in decision making, and where the budget is concentrated will give us a greater insight into Digital Transformation within the IT Service Management (ITSM).

BY SCARLETT BAYES
SDI INDUSTRY ANALYST

Digital Transformation is a comprehensive term, and there is a vast amount of information available surrounding it. However, the problem has arisen where there is no clear definition of Digital Transformation; there is much speculation of what it means as a concept. The Service Desk Institute (SDI) defines Digital Transformation as the term given to the implementation of catalytic technologies, frameworks, and methodologies designed to improve efficiency, productivity, and customer experience.

Furthermore, Digital Transformation does not just affect the service desk, or even just IT; it affects the whole organisation. Therefore, it is essential for all aspects of a

business to work holistically to understand how Digital Transformation can benefit them and help their business to evolve and become more efficient, as well as provide new ways to support business customers and ultimately offer a better customer experience.

Between March and April 2018, the Digital Transformation survey was sent to a wide variety of service desk professionals, from both public and private sector service desks and an extensive range of organisation sizes.

Digital Transformation

HAS YOUR SERVICE DESK/ BUSINESS UNDERTAKEN A DIGITAL TRANSFORMATION PROJECT?

Fig 1

(Fig 1) Nearly half of respondents specified that their service desk had undertaken a Digital Transformation project, and over a quarter highlighted that there are plans to do so in the near future. 31% identified that their service desk is not currently undertaking a Digital Transformation project. Transformation of any kind can be a scary prospect, and it can be difficult for some people to accept change. However, if organisations resist change and do not adapt, they risk becoming irrelevant. Digital Transformation is no longer something businesses can ignore, but it is essential for organisations to understand the capabilities and limits of the support function before undertaking a Digital Transformation project.

CURRENTLY, UNDERTAKING OR PLANNING TO UNDERTAKE A DIGITAL TRANSFORMATION PROJECT

WHAT DID YOUR SERVICE DESK/BUSINESS DO TO PREPARE FOR YOUR DIGITAL TRANSFORMATION PROJECT?

(Table 1) - Of the 69% of respondents that are undertaking or plan to conduct a Digital Transformation project, the majority reviewed and refined their processes in preparation. No matter what the project entails, it is essential to evaluate and improve processes, as doing this will highlight inefficient and wasteful processes which may be taking up valuable time and resources, both of which are crucial for a successful Digital Transformation project.

65% and 63% engaged with their customers and the service desk team, respectively. It is encouraging to see that the majority of respondents have consulted their customers to discuss what they require from new implementations, as this signifies that these service desks follow a more customer-centric approach to service management, which fosters a better customer experience and, if applicable, customer adoption of an implementation.

It is also essential to engage with service desk staff to discuss the implications that a new application may have.

For example, a self-service portal can remove some of the more repetitive and time-consuming tasks from a service desk analyst, such as incident or service request logging, categorisation, and prioritisation.

However, it also adds potential new responsibilities that analysts may need to undertake, such as ensuring the information the customer has inputted during the self-service process is extensive enough or updating the status of the incident or request through the portal. Communicating with the service desk team is crucial to ensure they understand the changes to their workload and environment that may occur.

Table 1

Depending on the type of implementation a Digital Transformation project entails, you may need to engage with potential tool vendors or technology partners. This action has been undertaken by 59% of respondents. It is crucial to spend ample time when researching potential vendors, as you need to be sure that the tool or technology you are investing in will meet the needs and expectations of your service desk, organisation, and customers. It is also essential to work closely with vendors and ensure they understand your business and its requirements.

48% of respondents highlighted that their service desk had to create a business case, and similarly, 30% had to obtain additional budget. A Digital Transformation project is a significant undertaking for any organisation. Therefore this is an important step to consider before beginning a Digital Transformation project. Furthermore, depending on the size of your organisation and implications of your project, it may be necessary to appoint as Digital Transformation Officer to manage and oversee the progress of the project, particularly if it will impact multiple areas of the business.

WHAT WERE THE MOTIVATIONS BEHIND UNDERTAKING A DIGITAL TRANSFORMATION PROJECT?
(Table 2)

As previously explained, Digital Transformation is about the implementations designed to improve efficiency, productivity, and customer experience. An incredible majority of respondents, almost 90%, specified that one of the motivations behind undertaking a Digital Transformation project was to improve the customer experience.

Furthermore, 78% of respondents pointed out that they were motivated partly by the increased productivity that a Digital Transformation project and its implementations could offer.
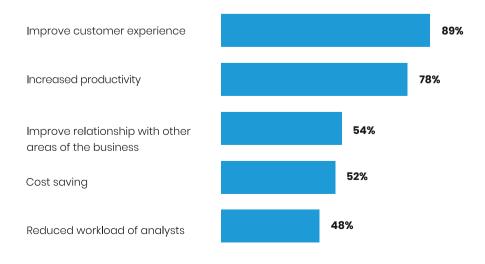
Moreover, improving the productivity and efficiency of the service desk can also signify that there are lower costs associated with service, which, as specified by 52% of respondents, is an attractive motivation for undertaking a Digital Transformation project.

48% of respondents pinpointed that they were motivated by the prospect of achieving a reduction in analysts' workloads.

Technologies like self-service can reduce the amount of repetitive, time-consuming tasks that service desk analysts typically perform, thus freeing up the time to perform more complex tasks, attributing to the overall productivity and efficiency of the support function.

Over half of respondents highlighted that they were also motivated by chance to improve relations with other areas of the business. Newer frameworks, methodologies, and ideologies, like Development and Operations (DevOps), promote communication and collaboration across multiple areas and teams across the enterprise.

Furthermore, if the goal of improved productivity is successful, this can improve the business' perception of the service desk, and therefore potentially improve the relationship between the service desk and the bigger company.

Improve customer experience	89%
Increased productivity	78%
Improve relationship with other areas of the business	54%
Cost saving	52%
Reduced workload of analysts	48%

Table 2

Digital Transformation

Self-Service **87%**

Shared Services (tools, frameworks, and processes) **70%**

Frameworks and/or methodologies (i.e. DevOps/Agile) **59%**
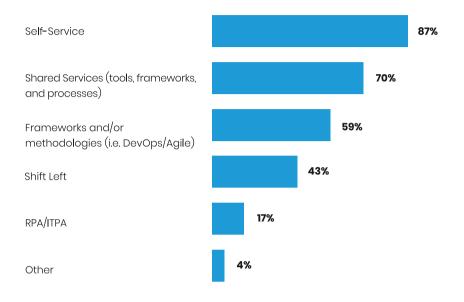
Shift Left **43%**

RPA/ITPA **17%**

Other **4%**

Table 3

WHICH OF THESE DOES YOUR DIGITAL TRANSFORMATION PROJECT ENTAIL?

(Table 3) - The term "Digital Transformation project" is incredibly broad and means different things to different organisations. Therefore, it is essential to understand what the industry is focusing on during their project. The majority of respondents highlighted that their project entails implementing self-service. When applied successfully, self-service can reduce or even eliminate the number of repetitive, low-value tasks, and allow the service desk, and IT support function as a whole, to take on more complex tasks. Self-service is not a new technology, yet a significant proportion of service desks have yet to implement it. Industry commentators and analysts place a heavy focus on cutting-edge technologies, such as Artificial Intelligence and Machine Learning, but for a large proportion of service desks, these technologies are not currently in their crosshairs.

43% of respondents highlighted that their project entails implementing a Shift Left initiative. Shift Left describes the movement whereby traditionally first-line tasks, such as ticket logging, are taken on by customers with technologies such as self-service, freeing up time and resources for first-line service desk staff to perform second line tasks, and consequently second line staff to take on third line tasks. Further analysis of the data showed that almost every respondent that highlighted they are undertaking a Shift Left initiative also plans to implement a self-service portal, which signifies that these service desks may understand the full potential self-service can have for the IT support function.

Robotic Process Automation (RPA) or IT Process Automation (ITPA), which can be considered to be more complex applications of automation, were specified to be part of 17% of respondents' Digital Transformation projects. While traditional automation functionalities, such as password resets or ticket routing, offer efficiency benefits, RPA and ITPA harnesses the power of software with artificial intelligence and machine learning capabilities to handle high-volume, repetitive tasks and automate complex processes. It would be interesting to see how this statistic changes in 2 years, as by this time, more advanced technologies may become more accessible for a broader range of organisations.
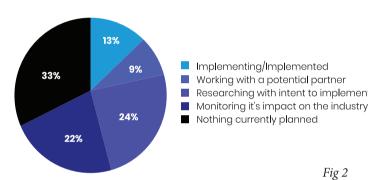
Interestingly, the next most common focus for respondents' Digital Transformation projects is a shift towards Shared Services, which offers service desks the opportunity to extend their value across a business by attempting to share best practices from different business units to boost performance, create service consistency, and a common language. Therefore, implementing a shared services model has financial benefits, as well as improving the efficiency of a business.

The name "Digital" Transformation suggests that every aspect of a project should involve a tool or technology. However, as pinpointed earlier, Digital Transformation can be defined as the vehicles which facilitate improved efficiency, productivity, and customer experience, whether this

comes in the form of technology, framework, methodology, or otherwise. As such, it is interesting to see that 59% of respondents highlighted their service desks' Digital Transformation project includes implementing frameworks, methodologies, or ideologies such as DevOps or Agile.

HOW MUCH IS ARTIFICIAL INTELLIGENCE (AI)/MACHINE LEARNING (ML) PLAYING A PART IN YOUR DIGITAL TRANSFORMATION PROJECT?

Fig 3

Fig 2

(Fig 2) - 55% of respondents highlighted that they are not currently planning to implement AI or ML as part of their organisation's Digital Transformation project, with 40% of this group monitoring the impact these technologies are having on the ITSM industry. Conversely, 13% of respondents highlighted that they are either currently implementing or have implemented AI or ML as part of a Digital Transformation project. Almost a quarter of respondents specified that they are currently researching AI and ML with intent to implement, and a further 9% are working with a potential partner. Both these stages are crucial before performing something as significant as AI or ML technologies, as failing to fully understand the needs of the business or the support function can lead to the introduction of technology that is not used to its full potential.

DO YOU HAVE A DEDICATED DIGITAL TRANSFORMATION TEAM?

(Fig 3) - Depending on the size of the organisation, the impact across different areas of the business, and the scope of the Digital Transformation project, it may be necessary to implement a team which is dedicated to managing and overseeing the progress of the project. 36% of respondents highlighted that they have a committed Digital Transformation team.
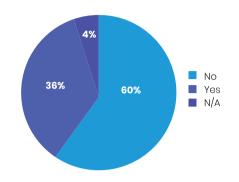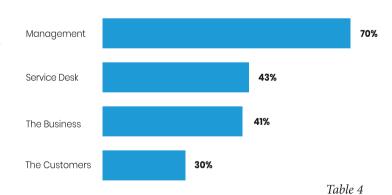
The majority of respondents, however, specified that there is no dedicated Digital Transformation team heading their project. Ideally, organisations may have a project management team or project management office who would manage such technology implementation projects. However, it would be interesting to know where further responsibility of such a project lies in these organisations; the service desk, IT managers, business managers, or another department or individual, and how this affects the efficiency and productivity of their regular tasks.

WAS THERE A PUSH TO UNDERTAKE A DIGITAL TRANSFORMATION PROJECT? IF SO, WHERE DID THIS COME FROM?

Table 4

(Table 4) - Knowing where the push for Digital Transformation derives from is necessary to understand the process for a service desk's evolution. Only 30% of respondents identified that their customers are pushing for transformation, whereas 70% of respondents highlighted that the push is coming from management. Similarly, 41% of respondents specified that the push for Digital Transformation came from the business.

Digital Transformation

There are challenges and benefits to both sides of this issue, as a push from customers can signify that the service is lacking and that customers are dissatisfied, or that they have been consulted on how they want to see the support capability developed with a Digital Transformation project. Similarly, with the push from management, there should be a balance to avoid service issues being created, by implementing changes too quickly for customers and perhaps service desk staff to be comfortable with, such as not considering the impact on the business and customer experience.

43% of respondents highlighted that the service desk pushed for Digital Transformation. This high number indicates that these service desks are looking to encourage their organisations to invest and innovate to become more efficient. Ensuring an organisation recognises the value of a service desk, and that the service desk can fully articulate its business value is a key consideration when trying to secure a budget for such initiatives.

There were also respondents who identified that the push for a Digital Transformation project came from more than one source.

This could signify that the service desk, management, and customers are all on the same page and that through cross-functional collaboration and productive business relationship management, these respondent organisations are moving forward together for the benefit of the whole organisation.

It could also signify, however, that multiple business stakeholders see Digital Transformation as a popular trend and a way to fix for a less than active service.

(Fig 4) - It is very encouraging to see that over half of respondents highlighted that their service desk team received the decision to undertake a Digital Transformation project positively and had a good outlook. Digital Transformation often means change, and generally, people can be averse to change and resist it.

Therefore, it is essential to adequately communicate the implications new implementations can have and discuss their concerns and work to ease any transition, mainly if it entails a culture shift.

For many staff in low-level positions, the prospect of technology replacing them in their role is a common concern. Therefore, it is understandable that 36% of respondents highlighted that their team had such concerns, but it is promising to note that these respondents' teams were mostly positive about the project.

11% of respondents highlighted that service desk staff had a significant number of concerns, but as previously noted, it is essential to work with the support team to ease their worries and communicate the benefits a Digital Transformation project can have.

The majority of respondents, 53%, identified that the service desk team had a positive outlook. It is also important to note that no respondents highlighted that their team resisted the decision to undertake a Digital Transformation project.

This could signify that service desk staff understand that Digital Transformation will have a positive on the service desk and broader organisation.

HOW WAS THE DECISION TO UNDERTAKE A DIGITAL TRANSFORMATION PROJECT RECEIVED BY SERVICE DESK STAFF?
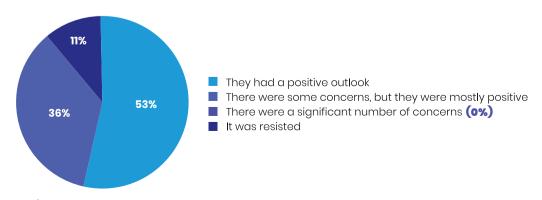

- They had a positive outlook
- There were some concerns, but they were mostly positive
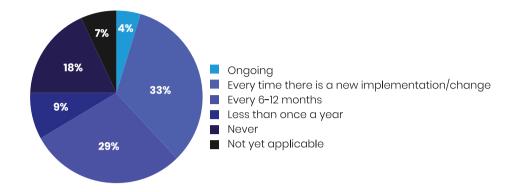- There were a significant number of concerns **(0%)**
- It was resisted

Fig 4

Digital Transformation

Fig 5

IF YOU HAVE A DIGITAL TRANSFORMATION STRATEGY, HOW OFTEN DO YOU REVIEW IT?

(Fig 5) - It is useful to form a strategy to lay out how your Digital Transformation project will progress. However, as time goes on and new implementations and changes are rolled out, it may be necessary to review the strategy to ensure that it remains relevant and the project will continue to meet the service desk's and business' aims.

A project may run into trouble if the environment detailed in a strategy is different from reality, therefore, considering some Digital Transformation projects involve changes which would affect an organisation's infrastructure, it is a good idea to regularly review your strategy to prevent any issues further down the line.

4% of respondents highlighted that their strategy is reviewed on an ongoing basis. This is undoubtedly an excellent way to ensure the approach remains relevant, but it is essential to ensure that this does not require too many resources or impede on the performance of the service desk.

The largest portion, 35%, specified that they review the Digital Transformation strategy every time a change or implementation is made. This is an excellent way to ensure that the Digital Transformation strategy stays relevant to the changing environment of the organisation.

The second largest group of respondents, 29%, identified that their strategy is reviewed every 6 to 12 months. Depending on how often implementations are rolled out, this length of review cycle would suit an organisation better than more frequent reviews.

However, it is vital to note the importance of finding what works best for your organisation, as every business is different and has different goals and requirements. A Digital Transformation strategy should be planned to best suit an organisation, as so should how often the approach is reviewed.

18% of respondents specified that their approach is never reviewed, and as previously mentioned, this can lead the strategy and project as a whole to ultimately fail. Furthermore, 9% who review their strategy less often than once a year may also encounter issues as their project progresses.

HOW LONG WILL YOUR DIGITAL TRANSFORMATION STRATEGY/PLAN LAST?

Fig 6

(Fig 6) - Many of the implementations which respondents have identified are not simple changes; for example, Shared Services and new frameworks or methodologies may represent a total change in the culture of an organisation, which can be particularly difficult and would take a long time to implement. Organisations which set their timeframe too short may be met with an overrun project or a rushed implementation. However, smaller organisations and small-scale implementations may indeed require less time to be fully and successfully implemented. Conversely, a strategy or plan

which is too long with no clear endpoint may be challenging to manage, mainly if it is poorly maintained or not reviewed regularly to ensure it is still relevant to the organisation's goals.

The most significant portion of respondents specified that their strategy would last 1 to 3 years; this is a reasonable length of time, as it balances the project being long enough to give it the best chance of being successfully carried out, with the strategy not being too lengthy to the point where it restricts progress.

Interestingly, 36% of respondents highlighted that their Digital Transformation strategy is ongoing. Assuming that in these cases, the plan evolves in tandem with a service desk's improving service delivery capability, IT's ability to better enable an organisation and a strategic approach to industry developments; this can be quite an advantageous approach to Digital Transformation. Looking at transformation as a continual process, where improvements and developments are implemented regularly, can create a culture which promotes a more fluid, agile and fast-paced approach to service management. It also has the benefit of enabling the service desk to stay relevant alongside the continually evolving technologies and trends the industry faces.

16% of respondents highlighted that their Digital Transformation strategy would last 3 to 12 months. As previously stated, IT may struggle to meet deadlines or perhaps rush to roll out implementations which may impact the success of a project. Of course, this is dependent on the size of the organisation and the implementation projects planned. Therefore one would hope that the Digital Transformation strategy had been thoroughly considered before beginning a Digital Transformation project. The smallest proportion, 9% of respondents, highlighted that their approach would last over three years. Again, as previously mentioned, it is vital to ensure that the strategy remains relevant to an organisation's goals as the plan progresses and as time goes on.

HOW FAR ALONG IS YOUR DIGITAL TRANSFORMATION PROJECT?

(Fig 7) - Knowing what stage respondents' Digital Transformation projects are at is a good indicator of maturity, but also how long the project has had to meet targets. 52% of respondents specified that their project is only in its initial stages; as such, these projects may not have met many targets as a project which has been in place longer. Similarly, 14% of respondents' projects are only in the

Not yet begun
Planning/creating a business case
Initial stages
Deployment
Maintaining and increasing capabilities

Fig 7

deployment phase, and a further 14% have either not begun yet or are still in the planning phase.

20% of respondents' projects are in the maintaining and increasing capabilities stage; these are the projects which will be better indicators of their success and impact on the organisations as they have been established longer and have had more time to meet requirements and targets.

HOW SUCCESSFUL HAS YOUR PROJECT BEEN SO FAR?

Very – it has met almost all CSFs and KPIs we set
Moderately – it has met some targets
Not very – it has not met many targets
Not at all – it has met no target/ had a negative impact on service
Not yet started/too early to tell

Fig 8

(Fig 8) - Given that over half of respondents identified that their Digital Transformation project is only in the initial stages, it is promising to see that 55% of respondents reported that their project has been moderately successful and met some targets. Moreover, promisingly, no respondents specified that their project has met no targets or had a negative impact on service. The majority of respondents, 55%, pointed out that their project has encountered some targets. A further 20% highlighted that their project had not met many targets. Again, considering most respondents specified that their project was only in its initial stages, this is not a concerning statistic.

Digital Transformation

No – there has been no noticeable change
Yes – we now make progress faster
Yes – we are now performing slower

Fig 9

HAS DIGITAL TRANSFORMATION IMPACTED YOUR PROJECT COMPLETION SPEED?

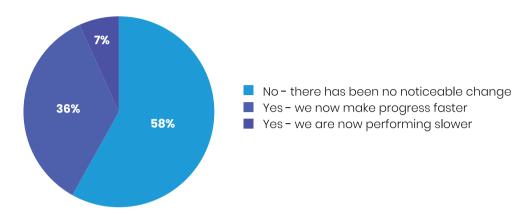(Fig 9) - One of the expected outcomes of Digital Transformation is faster project completion speed, supported by increased productivity and performance. 36% of respondents highlighted that they have indeed noticed that they are making progress faster as a result of their Digital Transformation initiative.

The majority of respondents specified that they had seen no noticeable change to their project completion speed. Considering only 20% of respondents' Digital Transformation projects are past the initial phases and deployment, it is understandable that the majority have not seen improvement in project completion speed yet.

Unfortunately, 7% of respondents specified that they are now performing slower than before. This could be for a multitude of reasons; perhaps the shift of focus to the project has removed resources and staff from their usual tasks, signifying that there are less available resources for other functions. Alternatively, if a

Digital Transformation project is still in its early stages, the service desk may still be adjusting to changes, and therefore processes and projects are progressing slower than usual.

NOT UNDERTAKING A DIGITAL PROJECT?

DO YOU THINK YOUR BUSINESS WILL UNDERTAKE A DIGITAL TRANSFORMATION PROJECT IN THE NEAR FUTURE?

(Fig 10) - Of the 31% of respondents who had initially stated that their organisations are not currently undertaking a Digital Transformation project, nearly 70% specified that they believe that they will conduct a Digital Transformation project soon, with 45% of this group determining there is already plans and budget for it. The remaining 55% identified that while they think their organisation will undertake a Digital Transformation project, there are currently no plans to do this. 33% of respondents specified that they do not believe their organisation will conduct a Digital Transformation project soon, but 63% of this group identified that they might undertake a project in the distant future.
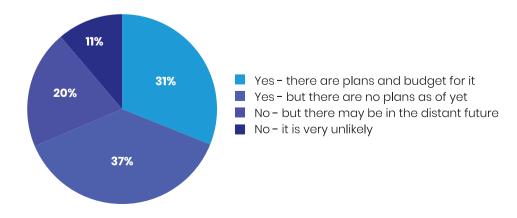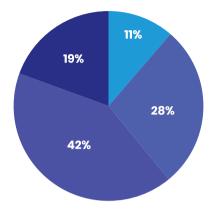

Yes – there are plans and budget for it
Yes – but there are no plans as of yet
No – but there may be in the distant future
No – it is very unlikely

Fig 10

- **Very** – there are plans in place and steps have been taken to prepare for it
- **Moderately** – there are some resources in place that could support a Digital Transformation project
- **Not very** – Our service desk/business has potential to undertake a Digital Transformation project, but there is still a long way to go
- **Not at all** – Our service desk/business has insufficient resources and infrastructure to undertake a Digital Transformation project

Fig 11

Only 11% of those currently not undertaking a Digital Transformation project highlighted that it is unlikely that their organisation will begin a transformation project at all. While this is a small proportion of the total number of respondents, it is still significant, and it is essential to understand why some organisations choose not to or merely think they are unable to, undertake a Digital Transformation project.

HOW PREPARED IS YOUR SERVICE DESK/BUSINESS FOR A DIGITAL TRANSFORMATION PROJECT?

(Fig 11) - As seen earlier in this report, before undertaking a Digital Transformation project, it is crucial to review your IT infrastructure, the support function's capabilities and resources, and the business and customers' needs in terms of service. Past this, there is a multitude of things to consider when planning a Digital Transformation strategy in terms of skills and abilities. From that of internal staff to implement and develop changes or tools, to the service desk staff's skills to maintain service levels and support new implementations, to end users' ability to use new implementation and whether there will need to be some user education for them.

Promisingly, 11% of respondents currently not undertaking a Digital Transformation project identified that there are plans in place and steps have been taken to prepare to begin a Digital Transformation project. A further 28% believe their service desk or business to be moderately prepared, specifying that there are some resources in place that could support a Digital Transformation project.

The remaining 61% of respondents are not so confident; 68% of this group specified that while there is potential for their organisation to undertake a Digital Transformation project, there is still a long way to go. The remaining 32% believe that their service desk or business is not at all prepared for Digital Transformation and that there are insufficient resources and infrastructure to undertake a project. While this is a significant proportion of respondents, it is promising to note that they recognise the need to be prepared for transformation.

IS THERE A SPECIFIC REASON YOUR SERVICE DESK/BUSINESS WOULD NOT UNDERTAKE A DIGITAL TRANSFORMATION PROJECT?

(Table 5) - As previously mentioned, it is essential to understand why some respondents feel their service desk would not, or is unable to, undertake a Digital Transformation project. This will give us an insight into what the industry struggles with daily, and what factors inhibit the transformation and development of a service desk. Most issues facing the service desk derive from lack of budget, time, and resources; this is evident here with these factors claiming the top 3 reasons as to why an organisation may not undertake a Digital Transformation project.

The cost associated with Digital Transformation seems to be the most significant factor preventing organisations from undertaking a Digital Transformation project. Depending on what a Digital Transformation project entails, it can come at a high cost for the organisation, be it in terms of purchasing a new tool or piece of technology, increased or enhanced resources, or a change in the infrastructure. As such, it can be challenging to secure budget or buy-in from relevant stakeholders if Digital Transformation is not part of an entire organisation's strategy. This barrier is noted by 31% of respondents who identified a lack of buy-in as a factor and 25% specifying Digital Transformation is not seen as necessary in

Digital Transformation

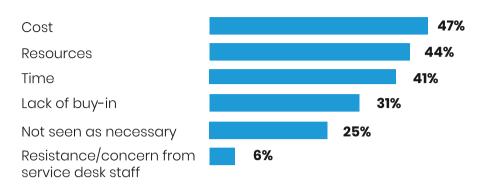|	
Cost	**47%**
Resources	**44%**
Time	**41%**
Lack of buy-in	**31%**
Not seen as necessary	**25%**
Resistance/concern from service desk staff	**6%**

Table 5

their organisation. Furthermore, a Digital Transformation project may not be a viable option for smaller service desks or businesses, which may contribute to a lack of buy-in from other areas of the business.
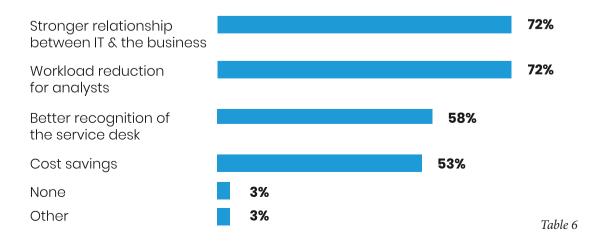
As specified by 44% of respondents, resources are another reason as to why their service desk or business would not undertake a Digital Transformation project. Previously, we have seen that ensuring there are sufficient resources in place is a crucial element to a successful Digital Transformation project. Considering the cost associated with securing more resources, this may not be a viable option for some service desks.

Time was identified as a barrier by 41% of respondents. Recent SDI research has shown that the majority of service desks struggle with firefighting and this consumes most of the support staff's time. Therefore, it is understandable that a significant proportion of respondents identified time as a factor preventing their organisation undertaking a Digital Transformation project.

The smallest portion of respondents identified resistance or concern from service desk staff as a key reason for not undertaking a Digital Transformation project. It is essential to allow your support staff to voice their concerns concerning any development or transformation. As previously mentioned, change can be a scary prospect, particularly for lower-level staff who feel they may lose their job to technology in the near future. However, adequate training and development opportunities can help to ease their anxiety and aide transition.

WHAT BENEFITS COULD YOUR ORGANISATION REALISE FROM DIGITAL TRANSFORMATION?

(Table 6) - It is interesting to note that one of the two most significant benefits that an organisation could realise with a Digital Transformation project, as highlighted by 72% of respondents, is a stronger relationship between IT and the business. Coupled with the 58% of respondents who identified they could realise better recognition of the service desk with Digital Transformation, it is

Stronger relationship between IT & the business	**72%**
Workload reduction for analysts	**72%**
Better recognition of the service desk	**58%**
Cost savings	**53%**
None	**3%**
Other	**3%**

Table 6

clear that the industry understands the importance and potentially the benefits of better communication and relationships across the business, IT, and the service desk.

There is potentially a link between the service desk's desire for a stronger relationship between IT and the business, the workload reduction for analysts, and the lack of buy-in or perceived necessity seen in the previous question. If a company does not realise the importance of the IT support function, it may not be able to understand the need for the service desk, and IT as a whole, to evolve and transform with new technologies, frameworks, methodologies, ideologies and so on, which could ultimately benefit the broader organisation. It is crucial that the business and IT work together to be able to understand the importance of each other's roles in the organisation, what their needs are, and how they can work together to improve the overall efficiency and productivity of the organisation.

A workload reduction for analysts has also been identified as a key benefit which organisations, specifically service desks, could realise from Digital Transformation. As previously seen, shifting analysts repetitive and time-consuming tasks to technologies like self-service and automation can significantly improve the productivity and efficiency of the service desk staff, and freeing up their time can allow analysts to take on more valuable tasks.

We have previously seen that cost is a significant issue for service desks in terms of undertaking a Digital Transformation project, yet 53% of respondents highlighted

that they could realise cost savings as a result of Digital Transformation. It would seem that many service desks struggle to gain buy-in from relevant business stakeholders and justify the necessary budget, despite the potential Return on Investment (ROI).

INDUSTRY VIEWS
HOW FAR DO YOU AGREE WITH THE STATEMENT THAT DIGITAL TRANSFORMATION IS ALL ABOUT IMPLEMENTING NEW TECHNOLOGIES?

13%	48%	34%	5%
Strongly Agree	Agree	Disagree	Strongly Disagree

Fig 12

(Fig 12) - At the beginning of this report, Digital Transformation was defined as the catalytic implementations designed to improve efficiency, productivity, and customer experience. There is a misconception that "Digital" implies that every aspect of a project must be technology base, yet this does not encompass frameworks and methodologies which can also allow an organisation to progress and enhance their IT support function.

When asked how far they agreed with the above statement, 61% of respondents agreed that Digital Transformation is all about implementing new technologies, with 21% of this group strongly agreeing. The remaining 39% disagreed with this statement, with 12% of this group strongly disagreeing.

HOW FAR DO YOU AGREE WITH THE STATEMENT THAT FRAMEWORKS AND METHODOLOGIES, SUCH AS DEVOPS AND ITIL, ARE A PART OF DIGITAL TRANSFORMATION?
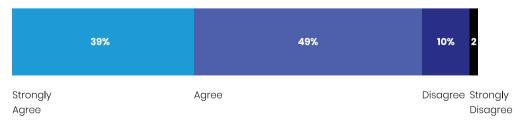
39%	49%	10%	2
Strongly Agree	Agree	Disagree	Strongly Disagree

Fig 13

Digital Transformation

(Fig 12) - Considering the responses to the previous question, one could expect a mirrored result in this question. Interestingly, however, when asked how far they agreed with the above statement, almost 90% of respondents specified that they agreed, with 44% of this group strongly agreeing.

Only 12% disagreed, with 2% of respondents strongly disagreeing.

DO YOU FEEL THERE IS PRESSURE FROM THE BUSINESS/ CUSTOMERS TO KEEP UP WITH DEVELOPMENTS IN THE INDUSTRY?

- Yes
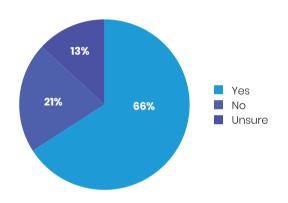- No
- Unsure

13%
21%
66%

Fig 14

(Fig 14) - We have previously seen that, respectively, 41% and 30% of respondents identified that a Digital Transformation project came as a result of a push from the business and customers.

Therefore, it is unsurprising to see that 66% of respondents highlighted that they feel there is pressure from the business/customers to keep up with developments in the industry.

Customer service in the consumer world is evolving rapidly, be it through implementing new products, services, technologies, or even frameworks, all of which are devised to improve the experience customers have when engaging with consumer services.

Customers then come to expect similar levels of customer service and a better overall experience of the services they are provided in a working environment. At some point, corporate business IT departments will need to develop their approach to service and use customer feedback to improve the service they provide.

CONCLUSION

With the majority of organisations currently undertaking or planning to conduct a Digital Transformation project, it is clear that the importance of evolving and transforming IT services is understood among the industry. Of the respondents that stated a Digital Transformation project is not currently in the pipeline, nearly 70% identified that they believe their organisation will undertake a project in the future.

Industry professionals highlighted that there are several steps that their service desk or business took to prepare for their Digital Transformation project, such as reviewing processes, engaging with customers, and obtaining additional budget.

The most common implementation for organisations was identified as self-service, which is interesting to note as self-service is not a new technology.

The implementation of concepts, frameworks, methodologies, and ideologies, such as Shared Services, Shift Left, DevOps, or Agile, also seemed to be relatively popular, which dispels the preconception that "Digital" Transformation is only about implementing technologies.

Encouragingly, the majority of service desk professionals noted that their support staff had a positive outlook surrounding their organisation's Digital Transformation project. However, it would not be unexpected to encounter some concern among service desk staff, and therefore it is essential to engage with your team to reassure them and understand their concerns before undertaking a Digital Transformation project.

A strategy is an excellent way to plan how a project will progress, but it is essential to review it often to ensure the approach remains relevant to what the organisation wants to achieve with Digital Transformation. It is also necessary to consider whether the length of a strategy adequately reflects how long it will take to implement changes successfully.

However, Digital Transformation is not without its difficulties; there are high costs associated with undertaking a project, such as the price of tools and technologies, increased or enhanced resources, and potentially more staff to take on roles pertinent to the project or the implementations. Furthermore, a lack of time

and buy-in can also present problems for support functions attempting to undertake a Digital Transformation project.

Transforming your IT support function is no easy feat; therefore, it is crucial to fully consider what your service desk, the business, and the customers require, and review your infrastructure, resources, and processes to ensure that your organisation can implement new tools or technologies.

Some implementations will need a change in culture, and this can be a particularly difficult transition for many organisations; this is, therefore, a significant factor to consider.

It has been mentioned several times throughout this report that specific technologies are not new to the industry, yet implementation rates are increasing.

One could surmise that rather than implementing new technologies, people's attitudes are changing regarding the way they work.

More modern frameworks, methodologies, and ideologies, as well as influences from the business and customers, are encouraging them to make use of the technology that is available to them, such as self-service, to transform their service to be more efficient and effective. **wn**

Energy efficiency and solar power

Energy price increases and the looming countrywide load-shedding are two of the biggest motivators to improve energy efficiency. There are many approaches one can take to reduce the amount of energy they are using, but the most popular one is solar energy. While often criticised as costly and ineffective, more and more people are opting for solar power due to its wide range of advantages and increasing affordability.

BY NICOLE VILJOEN
PROJECT ADMINISTRATOR
ENERGAS TECHNOLOGIES

The options range from an utterly off-the-grid system to a hybrid inverter and battery, which enables the user to integrate power from their solar PV panels, the national grid and batteries. It also incorporates a mobile app to track energy usage and savings in real time.

The average South African family home requires a 5 to 7 kW solar photovoltaic (PV) system with multiple converters and batteries for backups. These systems can provide up to 30% of an average home's energy and can cost anything from R80k and up. Going partially off-grid might cost less, but smaller systems only provide enough power for lighting and lower wattage appliances and typically do not power the geyser and the stove.

The initial investment is enough to scare one off. However, future benefits make solar power the obvious choice. Installing a solar system is not just a matter of putting

up a few solar panels, there is no standard system, and each system has to be correctly sized to suit the needs and requirements of the user.

KEY CONSIDERATIONS

Other than cost, there are a few other factors which also need to be considered, such as space, the condition and lifespan of your roof, as well as maintenance. South Africa is blessed with some of the best quality solar radiations in the world, and

solar panels are built to work in all climates, but in some cases, rooftops may not be suitable for solar systems due to age, slope or tree cover.

Compare the warranty of your roof with that of the solar panels to ensure that you won't need to pay extra to dismantle the system and then put it up again if you need to renovate or replace the roof. Before you go ahead with any installation, make sure that your roof has enough space for the

solar panels and that the structure of your roof can handle the additional weight of the solar panels.

A solar system sufficient to run your house will require many panels and batteries. This involves a lot of roof space and space for the batteries. Keeping the batteries cool, dry and safe at all times is essential, and storage of the battery system is space intensive. Some batteries may give off dangerous gasses.

Energy Efficiency

Ensure that there aren't any trees shading the panels. Solar panels require specific placement to generate the maximum amount of power. For maximum efficiency, it is recommended that solar panels should be installed perpendicular to the sun's rays, and track the sun as it moves from east to west. Keeping your solar panels working and your roof in good condition is all about establishing proper maintenance procedures.

It's a good idea to find out from your installer what those maintenance procedures are before the installation begins. If you are unable to meet those maintenance requirements, there is a good chance your equipment will not last as long as you want it to.

Further to the installation of a solar system, you will need to follow up with your insurance provider on your coverage. Having the right insurance to cover both yourself and any damage to your property is something you need to consider.

COST ISSUES

Despite decreasing in price over the last few years, solar energy systems can still be quite expensive. If budget or space is an issue, starting with a smaller solution is a smart option. Whether you go completely off-grid or merely supplement your household energy intake with a smaller system, it will already be a good start to increase your property value.

The amount of solar energy you need to produce depends on how much you use, so it makes sense to trim your usage as much as possible before paying for all those panels. Start with an energy audit and look for efficiency upgrades before you spend

all that money. Insulating your home and using energy efficient appliances and light fittings can play a role in reducing your energy consumption. Using a solar water heater and a gas stove can reduce up to 40% of your power consumption. These options mixed with a smaller solar installation can deliver immediate savings and a shorter wait for a return on investment.

Energas offers Viessmann's Solar Thermal range. The Vitosol 200-FM is a premium series flat plate collector that delivers high performance and quality construction at an affordable price. With an absorber area of 2,3 m², the solar collectors can be adapted to meet any energy demands.
On average, they annually replace up to

60% of the energy required for domestic hot water heating and contribute to central heating back up. In conjunction with a condensing boiler, free solar energy allows you to reduce your annual energy consumption for heating and domestic hot water by more than one third. Our product range also includes gas geysers that can operate on LPG or natural gas for domestic hot water or industrial heating solutions.

To achieve a return on your investment will take several years. The initial outlay is, and hire-purchase models and monthly repayment options are not readily available yet.

Even if a full system's initial investment is out of reach, there are more affordable ways to take advantage of solar energy such as a solar thermal hot water heating system. **wn**

REFERENCES

- file:///C:/Users/USERPC/Downloads/want-solar-panels-on-your-.pdf
- file:///C:/Users/USERPC/Downloads/think-before-you-p.pdf
- file:///C:/Users/USERPC/Downloads/the-major-advantages-and-disadvantages.pdf
- file:///C:/Users/USERPC/Downloads/solar-power-does-it-make-financial-.pdf
- file:///C:/Users/USERPC/Downloads/https___www.electricchoice.pdf
- file:///C:/Users/USERPC/Downloads/how-much-it-costs.pdf
- file:///C:/Users/USERPC/Downloads/CSIR_Conradie_2010.pdf

Since 2006, we have been involved as consulting electrical engineers across a broad spectrum of projects. These include housing estate reticulation, office buildings, warehousing, shopping centres, automobile dealerships, training facilities, and emergency generating systems, to name a few.

DEDICATED TO DESIGNING YOU A SAFER GREENER ENERGY EFFICIENT FUTURE

With a combined 60 years experience, we have developed a niche in various key projects in the electrical and construction industry. We are dedicated to provide the technical skill and service you deserve.

Good day ladies and gentlemen
As a grey-beard of 70 years old, I have been around the block a few times. I have managed switchgear manufacturing companies for around 45 years, and during this time I have seen our industry go through numerous different phases … dynamic growth, stagnation, confusion, and painful decline.

Against this backdrop, I feel privileged to share with you some of my thoughts, perceptions and research findings regarding the challenges facing South African panel manufacturers.

BY JOHAN BASSON I SMSAIEE

This article looks at some of the challenges that face the electrical panel-building industry in South Africa. It will focus primarily on manufacturers who serve the industrial sector which include MMM, water, petrochemical, paper and pulp, cement, material handling, automotive, food and allied, and energy.

It does not generally look at SOEs, municipalities, agriculture or commercial type projects such as shopping malls, hospitals, etc., but I suspect that manufacturers in these sectors face the same challenges.

When we use the term panel builders, we are referring to manufacturers of low voltage switchgear and controlgear assemblies as defined in the IEC 60439, 61439 and SANS 1973 series of standards.

In producing the presentation, I have invited input from several prominent and independent panel builders operating in the region, as well as statistical data from industry associations including SEIFSA, and feedback from the NETFA test laboratory of the SABS.

OVERVIEW OF PANELBUILDERS

There are three categories of panel builders: International OEMs who have invested in the establishment of manufacturing facilities here in South Africa. In most instances, core parts are supplied from the OEMs central plants overseas, while the manufacturing of selected components is done here before the panels are assembled and populated. In these cases, the designs are mainly developed and tested overseas.

Usually have a comprehensive product range consisting of switchgear, drives, control equipment, PLCs and other intelligent devices.

Typically prefer to sell a 'total solution' offer, and do not promote the concept of 'other' equipment in their panels.

Their assemblies usually carry a comprehensive type test certification but are populated with the OEMs own equipment only.

The Challenges Facing South African Panel Manufacturers

OEM partner manufacturers who manufacture and/or assemble OEM designs in South Africa under license, or other special agreement. They will usually have been trained and provided with the required engineering software and special tools. Also, the OEM will provide a formalised EDS Manual to ensure compliance and consistency. The panels are populated by the partner company in South Africa. The designs and type testing in these cases are also done overseas. There are two versions available:

Designs which are compatible with more than one make of primary switchgear components. These are designs which are usually provided by system manufacturers who are not switchgear OEMs, OEM systems which are intended for principal switchgear components manufactured by the same OEM. (Their own product)

South African Manufacturers who manufacture designs which were locally developed, and type tested at laboratories in South Africa and/or abroad.

Locally designed and developed panels are type tested to the same IEC standards as the international OEM designs.

There are some cases though where earlier tests were performed against the IEC 60439 series of standards which have been superseded by the IEC 61439 series of standards. Local manufacturers argue that more visible recognition should be given under the IEC 61439 umbrella for the tests which were performed because the test protocols themselves have not changed,

Panel Manufacturer Challenges

and many users wrongly assume their panels are no longer compliant.

Although the SANS 10142-1 Code of Practice still refers to the IEC 60439 and SANS 1973 series of standards, many users, consultants and specifiers request compliance with the new IEC 61439 series, and this has resulted in most of the local panel builders re-testing their designs against the new standards.

SO, WHAT ARE THE CHALLENGES?

We face numerous challenges, but I will start with the most obvious one:

SOCIO-ECONOMIC CHALLENGES

Project activity inside South Africa has declined and become erratic over recent years. This impacts directly on the manufacturing sector. Contributing factors include:

- Political instability and insecurity;
- State capture, corruption and mismanagement;
- Infrastructure constraints;
- Low productivity (manufacturing cost);
- Lack of skills development;
- Negative perceptions of potential investors.

Employer-body SEIFSA circulated a document titled 'Map to a Million' which was produced by a corporate association of manufacturers, called the manufacturing circle. This document addresses the efforts of industry groups to create a million new jobs over the next decade.

They strongly recommend that business needs to prioritise the importance of local procurement both within the industry and by end-users.

They also feel that business should support 'proudly South African' initiatives in doing what some labour unions are achieving – tracking and flagging those tenders that can be executed locally but are designed for imports.

They encourage business to work with consumers to understand better the importance of supporting local manufacture.

In some instances, for example, BBBEE accredited suppliers have been awarded contracts for which they import the products while existing local manufacturers with a lower accreditation level but higher employment numbers have been compromised.

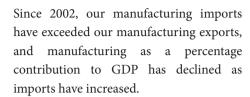I will touch on a few other key points worth noting:

GENERAL OVERVIEW

South Africa is at a tipping point. Record levels of unemployment, rising poverty levels and, increasing political uncertainty have created an environment where investors are understandably cautious and are instead seeking investment opportunities abroad.

If we continue on our current low road, the prospect of an IMF intervention beckons, with the associated loss of sovereignty in determining our own economic future.

Against this backdrop, we run the risk of a toxic cocktail of continued further de-industrialisation and job losses.

Since 2001 our manufacturing sector has experienced a trade deficit peaking at a whopping R500 Billion in 2016.

Since 2002, our manufacturing imports have exceeded our manufacturing exports, and manufacturing as a percentage contribution to GDP has declined as imports have increased.

The paper encourages more significant commitment to support local manufacturers as a key element to stimulate economic growth and job creation.

ON THE LABOUR FRONT

Since 2013 unemployment has reached a crisis level of 27.7%.

Increasing labour costs have resulted in half a million jobs being shed. Wages are increasing, but productivity is falling.

Between 2000 and 2011 labour cost increased by 34% while productivity increased by only 13%.

THE POTENTIAL OF S.A. MANUFACTURING

Creating additional demand for locally manufactured goods will promote economic growth. While domestic demand is not sufficient to sustain the industry, it is an excellent base from which to build a dynamic export industry.

Stimulating domestic demand will boost investor confidence when coupled with policy certainty, supportive regulation and competitive incentives, accompanied by appropriate supply-side policies that build the skills base and support technological upgrading.

The manufacturing sector employed 1.8 million people in the 2nd quarter of 2017 which represents 12% of the country's 16.1 million total jobs, or 39% of the

4.6 million in the real economy which include manufacturing, mining and construction. Manufacturing has the highest job multiplier of any sector.

Manufacturing's contribution to GDP has fallen from 24% in the early 1980s to less than 13% in 2017. This trend threatens prospects for continued economic upliftment, transformation and growth.

SA Manufacturing performance is lagging when compared to countries such as Malaysia, South Korea and even the DRC. For its stage of economic development, RSA manufacturing should be contributing at least 50% more to GDP than it currently does. (±20%)

INTERNAL CHALLENGES
TYPE TESTING ISSUES AT THE SABS

Type testing is essentially a range of safety and performance tests to confirm the assembly's design and build integrity against the manufacturer's ratings for the product.

Perceptions arose that the SABS laboratories cannot perform the full suite of tests required in IEC 61439-1 and 2. While not every test could be performed at NETFA, their Groenkloof laboratory and Gerotek could provide the services to fulfil the requirement. First prize, of course, would be that NETFA can perform all the tests.

The SABS did indicate at various stages that some of the test facilities needed to be overhauled or upgraded, and so a new status report on the laboratories is now overdue.

Damaging rumours were also spread that the quality of testing performed by the SABS laboratories was inferior. This caused some customers to insist on panels which were type-tested overseas. It was generally felt that these rumours were mischievous and with ulterior motives.

There are other independent testing facilities such as Gerotek, and local manufacturers have appealed to the SABS to accept and recognise their testing for incorporation into the standard SABS test reports to confirm compliance with the IEC standards. It is clear that all test protocols and results must at all times comply with the IEC standards.

Cost of type testing is prohibitive for smaller, South African manufacturers. It appears that local pricing has been based on the pricing of European test laboratories. Given the low manufacturing volumes here, it is virtually impossible to recover the cost of testing within a reasonable period.

Given the fact that we need to grow local manufacturing, it follows that type testing should be more accessible and affordable for South African manufacturers. This will stimulate the necessary initiatives for growth.

Some local panel manufacturers who performed their IEC 61439-1 and 2 type testing with independent test laboratories in Europe claim that their total testing costs inclusive of shipping, flights and accommodation was around 30% cheaper than they were quoted by the SABS in 2018. Besides, the waiting period for a testing slot was around two months, vs the nine months offered by SABS-NETFA.

Until recently, the SABS laboratories would not perform 'special testing' or 'development testing' against selected clauses of the IEC 60439/61439 standards. This caused significant challenges for manufacturers who wanted to develop their products. It is understood that this issue has been elevated to Board level, and that agreement may have been reached to allow the testing as mentioned above.

There is a need for the various SABS working groups to address the contradictions of multiple documents listed in the SANS 10142-1 code of practice.

Over recent times a perception has formed at end-user level consultants and specifiers that internal arc mitigation is a standard requirement on switchgear assemblies. This is not the case. While the requirements detailed in the IEC 61641/TR can be requested it is optional and subject to agreement between the manufacturer and the end-user.

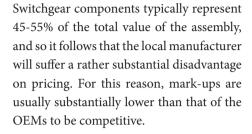I understand that SABS will or may have already addressed these issues at this conference.

OEMS - WHO MANUFACTURE?

Independent local manufacturers often have to compete with OEM manufacturers, using that OEMs switchgear components inside their assemblies.

This often puts the local manufacturer at a disadvantage, since his nett purchase cost for the parts is much higher than that of the OEMs internal manufacturing division, which enjoys favourable internal transfer costs for the components.

Panel Manufacturer Challenges

Switchgear components typically represent 45-55% of the total value of the assembly, and so it follows that the local manufacturer will suffer a rather substantial disadvantage on pricing. For this reason, mark-ups are usually substantially lower than that of the OEMs to be competitive.

OEMs often pass special project discounts to selected project houses, consultants or integrators equal to or better than the panel builders, who then free issue the switchgear components to the local manufacturers for incorporation into the assemblies.

Sheetmetal, copper and labour alone do not provide sufficient income for the local manufacturer to remain viable under such circumstances, and it is felt that as re-sellers for the OEMs equipment, discounts should be so structured to allow the local manufacturers to add a fair mark-up, but still be competitive.

OTHER

Other challenges include compliance with the revised code of practice for BBBEE implementation and the new employment equity act. My understanding is that the commitment is there, but execution often brings some difficulty with meeting specific accreditation targets, for example 'enterprise development' and 'employment equity'.

When you operate in a harsh economic environment where margins are often limited to single-digit percentages, it can be difficult to spend 6% of your company payroll on training. In such times the focus may change from 'transformation' to survival'.

OUTSIDE CHALLENGES

Local manufacturers have to compete with offerings from China, Eastern Europe, Malaysia, India, Korea etc. whose prices are often lower, but on many occasions, it has been found that the assemblies do not comply with relevant standards.

In some cases, local manufacturers are then approached to bring them up to standard and to issue a declaration of conformance (at extra cost).

In other instances, non-compliant assemblies are installed and commissioned on various sites.

Another trend that has become evident is to procure chassis plates for electrical assemblies entirely populated and wired from suppliers overseas, essentially outsourcing the components, consumables and labour to companies abroad.

Information gained indicate that these companies can buy the OEM components much cheaper than we can here. This has raised many eyebrows, as to how, for example, companies in Europe can buy OEM components, and export them to South Africa inclusive of duty, freight and mark-up, for cheaper than local companies can buy these components from the OEMs.

There is a growing sentiment that local manufacturers are having to operate in an economic environment that cannot be regarded as 'normal and stable' and so they should enjoy some form of control on imports. Understandably this is a complex dilemma as we are witnessing in the USA, but it is clear that something needs to be done.

CONCLUSION

So, we know that imports kill local manufacture, which results in high unemployment and political instability. Manufacturing has the best potential and leverage for new job creation, but to achieve that we need to:

- Increase productivity and quality
- Uplift skills levels
- Introduce incentives to encourage and promote local manufacture
- Initiate a manufacturing culture at schools
- Encourage local companies to commit to more in-house training and development

Unfortunately, local manufacturers who deal with the difficult situations we have in this country, sometimes create their own internal challenges by becoming negative, despondent and over-critical.

At such times we need to dig deep to find inspiration and motivation. Most of us have our roots here, we are children of this land, and I want to encourage you all to remain resilient, innovative and a positive ambassador for South Africa's manufacturing industry.

As a country, we need to put urgent remedial measures in place to establish ourselves as a respected and competitive manufacturing force in the global context.

Our growing levels of unemployment need to be turned around. The most effective way to create jobs is to increase our manufacturing capacity and capability.

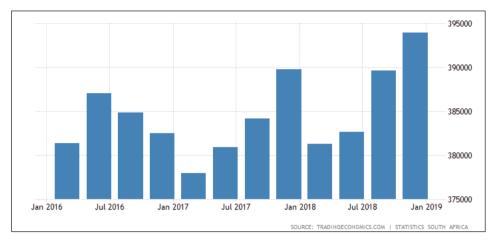Incentives should be put in place to encourage, promote, empower and

incentivise local manufacturing.

We should initiate a manufacturing culture awareness at schools and other learning institutions.
As local manufacturers, we should commit ourselves to do more in-house training and skills development.

We should strive towards increased productivity, better quality and a more positive approach towards the potential which lies dormant in our country. In the face of everyday doom and gloom, we need to continue the drive to convince the world that we are a viable and attractive manufacturing destination. **wn**

South Africa GDP From Manufacturing

The New SI Unit Definitions

On 16 November 2018 in a landmark decision, representatives from 60 countries voted to redefine the International System of Units (SI), changing the world's definitions of the kilogram, ampere, kelvin and mole forever. The decision, made at the 26th General Conference on Weights and Measures in Versailles, France, which is organised by the International Bureau of Weights and Measures (BIPM Bureau International des Poids et Mesures), means that all SI units will now be defined in terms of constants that describe the natural world.

BY DUDLEY BASSON

This will assure the future stability of the SI and open the opportunity for the use of new technologies, including quantum technologies, to implement the definitions.

The changes, which will come into force on 20 May 2019, will bring an end to the use of physical objects to define measurement units. The new definitions will not however affect the values of the units.

Barry Inglis, Director of the International Committee for Weights and Measures remarked: *"Today marks the culmination of decades of work by measurement scientists around the world, the significance of which is immense. We will now no longer be bound by the limitations of objects in our measurement of the world, but have universally accessible units that can pave the way to even greater accuracy, and even accelerate scientific advancement."* BIPM Director Martin Milton declared: *"The SI redefinition is a landmark moment in scientific progress. Using the fundamental constants we observe in nature as a foundation for important concepts, such as mass and time, means that we have a stable foundation from which to advance our scientific understanding, develop new technologies and address some of society's greatest challenges."*

The new definitions impact four of the seven base units of the SI: the kilogram, ampere, kelvin and mole, and all units derived from them; such as the volt, watt, coulomb, ohm and joule. The previous unit definitions will be abrogated.

- The kilogram - will be defined by the Planck constant (h) which in turn defines the energy of photon quanta for a specific frequency.
- The ampere - will be defined by the elementary electrical charge (e), which in turn also defines the value of the coulomb.
- The kelvin - will be defined by the Boltzmann constant (k).
- The mole - will be defined by the Avogadro constant (N_A).

It has been suggested that the new SI definitions should be known as the 'Quantum SI Units'.

The new definitions require exact values for the natural constants:

- The Planck constant h is exactly $6,626\ 070\ 15 \times 10^{-34}$ joule-second (J·s).
- The elementary charge e is exactly $1,602\ 176\ 634 \times 10^{-19}$ coulomb (C).
- The Boltzmann constant k is exactly $1,380\ 649 \times 10^{-23}$ joule per kelvin (J K^{-1}).
- The Avogadro constant N_A is exactly $6,022\ 140\ 76 \times 10^{23}$ reciprocal mole (mol^{-1}).
- The speed of light c is exactly $299\ 792\ 458$ metres per second (m s^{-1}).
- The ground state hyperfine structure transition frequency of the caesium-133 atom is exactly 9 192 631 770 hertz (Hz).
- The luminous efficacy of monochromatic radiation of frequency 540×10^{12} Hz is exactly 683 lumens per watt (lm W^{-1}).
- The von Klitzing constant $R_K = 25\ 812,807\ 459\ 3045\ \Omega = h/e^2$ (15 significant digits)

- The Josephson constant
  $K_J = 483,597\ 848\ 416\ 984$
  THz V^{-1} = 2e/h   (15 significant digits)
- The fine structure constant
  $\alpha = e^2/2\varepsilon_0 hc = 7,\ 297\ 352\ 566\ 4\ldots \times 10^{-3}$
  This number is frequently used as its inverse: 137,035 999 138…

Prof Arnold Sommerfeld (1868-1951) introduced his fundamental fine structure constant in 1916. This is a dimensionless physical constant characterising the strength of the electromagnetic interaction between elementary charged particles.

Prof Sommerfeld tutored a large number of prominent scientists, several of whom became Nobel laureates.

Constant α can be expressed in several different forms involving: e , ε_0, μ_0 , c , ℏ and R_K .

The Planck constant h is often used as ℏ = h/2π.   Scientist Richard Feynman (1918-1988) despaired of ever finding an analytical derivation of α. This constant is interesting in that it relates three

very important domains of physics: electromagnetism in the form of the charge of the electron, relativity in the form of the speed of light, and quantum mechanics in the form of Planck's constant.

The symbol sr stands for the dimensionless unit steradian.

The mole is a humongous number. If we make a stack of a mole of 100 micron copier paper, the stack will have a height of 6,3655 light years – much more than the distance to the nearest stars in the

The New SI Definitions

THE NEW QUANTUM SI BASE UNITS			
UNIT	MEASUREMENT	SYMBOL	ABRIDGED DEFINITION
Second	Time	s	Taking the unperturbed ground-state frequency of the caesium 133 atom in Hz as 9 192 631 770 which is equal to s^{-1}.
Metre	Length	m	Taking the fixed numerical value of the speed of light in vacuum as 299 792 458 expressed in $m\ s^{-1}$.
Kilogram	Mass	kg	Taking the fixed numerical value of the Planck constant h to be 6,626 070 15 x 10^{-34} expressed in units J·s, which is equal to $kg\ m^2\ s^{-1}$
Ampere	Current	A	Taking the fixed numerical value of the elementary charge to be 1,602 176 634 x 10^{-19} expressed in coulombs, which is equal to A s.
Kelvin	Temperature	K	Taking the fixed numerical value of the Boltzmann constant k to be 1,380 649 x 10^{-23} when expressed in the unit $J\ K^{-1}$, which is equal to kg $m^2\ s^{-2}\ K^{-1}$.
Mole	Amount of substance	mol	One mole contains exactly 6,022 140 76 x 10^{23} elementary entities. This number is the fixed numerical value of the Avogadro constant.
Candela	Luminous intensity	cd	Taking the fixed numerical value of the luminous efficacy of monochromatic radiation of frequency 540 x 10^{12} Hz to be 683 when expressed in the unit lm W^{-1}, which is equal to cd sr W^{-1}, or cd sr $kg^{-1}\ m^{-2}\ s^3$.

Milky Way galaxy. When working with very large numbers it is sobering to note that the Universe has a size of 29,7185 x 10^{28} millimetres.

A description of the development of the previous definitions, from the original metric, to the CGS (centimetre, gram, second) followed by the Giorgi which led to the MKS (metre, kilogram, second) and eventually to the SI (*Le Systéme International d'unités*) can be found in the October 2013 issue of **watt**now (Page 52). A full list of the SI prefixes is also given as well as a description of the astonishing Planck system of natural units.

An important aspect of unit definitions is the '*mise en pratique*' which is the method by which the value of the unit can be realized from the definition. In several cases in the past it was not possible to realize the values directly and physical prototypes had to be used instead.

The original definition of the kilogram (*grave*) was the mass of a cubic decimetre of pure water at standard temperature. Although adequate for practical purposes this could hardly achieve an accuracy of much less than a milligram.

The definition of the kilogram which has been in use for more than 130 years, represented by the International Prototype of the Kilogram (IPK), was a cylinder of a platinum iridium alloy stored at the BIPM in France. This was stored inside three bell jars. Some forty copies were made and distributed around the world. It was found that the mass of the various copies had diverged from one another, over the years, by tens of micrograms, probably due

International Prototype of the Kilogram kept in three bell jars in an underground vault of the BIPM at Sèvres.

to mercury adsorption from the atmosphere. Mercury vapour is released in trace quantities to the atmosphere by the combustion of coal and also by car exhausts.

The kg prototype will be replaced by the Planck constant - the fundamental constant of quantum physics. While the stability of the IPK could only be confirmed by comparisons with identical copies, a difficult and potentially inaccurate process, the Planck constant is ready for use everywhere and always.

The new definition of the kilogram is the most remarkable of the new definitions and removes the last remaining prototype from the system. Working with units as small as the Planck constant and the elementary charge may seem challenging to the point of madness. The instrument used for the kg '*mise en pratique*', initially known

as a Watt balance, has been renamed the Kibble balance in honour of Bryan Kibble at the U.K.'s National Physical Laboratory (NPL), who conceptualized it in 1975. Naming this extremely delicate instrument after James Watt may seem bizarre – Watt introduced the unit Horsepower to give prospective users of steam engines an easily grasped measure of the capabilities of the engines.

The Kibble balance is an exquisitely accurate weighing machine. Like any balance, it is designed to equalize one force with another. In this case, the weight of a test mass is exactly offset by the force produced when an electrical current is run through a coil of wire immersed in a surrounding magnetic field.

The surrounding field is provided by a large permanent magnet system or an electromagnet.

The moveable coil, once electrified, becomes an electromagnet with field strength proportional to the amount of current it conducts. When the coil's field interacts with the surrounding magnetic field, an upward force is exerted on the coil. The magnitude of that force is controlled by adjusting the current.

Current and voltage are measured in two separate stages, or modes, of operation.

WEIGHING/FORCE MODE

In "weighing" or "force" mode, a test mass is placed on a pan that is attached to the coil. It exerts a downward force - its weight - which is equal to its mass (m) times the local gravitational field (g). The current applied to the coil is then adjusted until the upward force on the coil precisely balances the downward force of the weight. When the system reaches equilibrium, the current is recorded.

At this point, it might seem that the job is finished. After all, the force (F) on the coil – which equals the weight of the mass – can be calculated with a simple equation that dates from the 19th century: $F = IBL$, where I is the current, B is the magnetic field strength, and L is the length of the wire in the coil. However, as a practical matter, the product BL is extremely difficult to measure directly to the necessary accuracy.

Fortunately, physics provides a way around that problem via yet another relationship revealed in the mid-19th century: induction. Michael Faraday discovered that a voltage is induced in a conductor

The New SI Definitions

when it travels through a magnetic field, and that the voltage is exactly proportional to the field strength and the velocity. So if the velocity is constant, the induced voltage is a sensitive measure of the field strength.
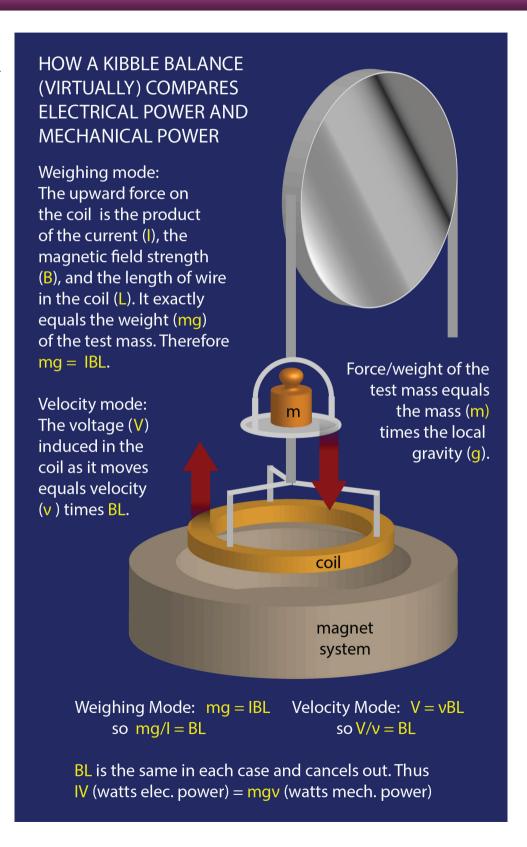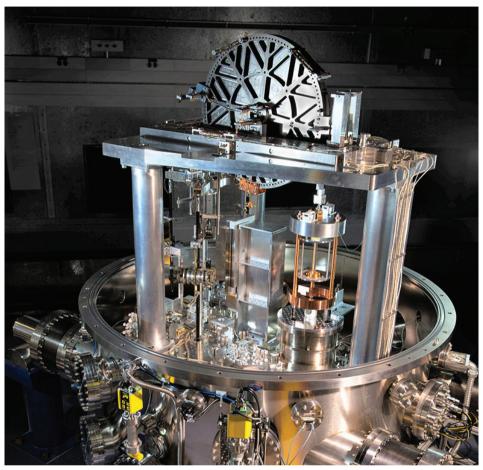
VELOCITY/CALIBRATION MODE

This phenomenon is the basis for the Kibble balance's second stage, called "velocity" or "calibration" mode. For this operation, the test mass is removed and the applied current through the coil is shut off. The coil is then moved through the surrounding field at a carefully controlled constant velocity. The resulting induced voltage is measured.

Again, an uncomplicated formula governs the magnitude of the induced voltage: $V = vBL$, where B and L are the very same field strength and wire length as in weighing mode, and v is the velocity. When this equation is combined with the one above for force on the coil, the problematic B and L cancel out, leaving $IV = mgv$. (That is, electrical power equals mechanical power, both expressed in watts.) Or, solving for mass, m = IV/gv.

Everything on the right side of that equation can be determined to extraordinary precision: The current and voltage by using quantum-electrical effects that are measurable on laboratory instruments; the local gravitational field by using an ultra-sensitive, on-site device called an absolute gravimeter; and the velocity by tracking the coil's motion with laser interferometry, which operates at the scale of the wavelength of the laser light.

Where is the Planck constant, h, in all this? It comes into play in the way current and voltage are measured using two different physical constants. Both constants are

HOW A KIBBLE BALANCE (VIRTUALLY) COMPARES ELECTRICAL POWER AND MECHANICAL POWER

Weighing mode:
The upward force on the coil is the product of the current (I), the magnetic field strength (B), and the length of wire in the coil (L). It exactly equals the weight (mg) of the test mass. Therefore mg = IBL.

Velocity mode:
The voltage (V) induced in the coil as it moves equals velocity (v) times BL.

Force/weight of the test mass equals the mass (m) times the local gravity (g).

coil

magnet system

Weighing Mode: mg = IBL   Velocity Mode: V = vBL
so mg/I = BL   so V/v = BL

BL is the same in each case and cancels out. Thus
IV (watts elec. power) = mgv (watts mech. power)

The NIST-4 watt balance has measured Plank's constant to within 34 parts per billion, demonstrating that the high-tech scale is accurate enough to assist with 2018's planned redefinition of the kilogram.

When the Kibble balance is used to take measurements the instrument must first be enclosed in a vacuum vessel.

The National Institute of Standards and Technology (NIST) has operated Kibble balances of various configurations since the early 1980s, shortly after the device was first conceptualized by Kibble. NIST now operates its fourth-generation instrument, called NIST-4.

MISE EN PRATIQUE FOR THE ELECTRICAL UNITS

The definitions of the units do not imply any particular experiments for their practical realization. Any methods capable of deriving the values traceable to the set of seven reference constants can in principle be used. A primary method is a method having the highest metrological properties, whose operation can be completely described and understood; for which a complete uncertainty statement can be written down in terms of SI units, and does not require a reference standard for the same quantity.

The ampere definition has seen several changes over the years. The definition by the deposition of silver in an electrolyte was extremely cumbersome, requiring the silver to be weighed and then the average current calculated for the specific time period. The more recent definition by the force between a metre of two infinitely long conductors could only provide a guide to measurement by other means. The ampere (alternatively coulomb) is the only SI base unit on which all of the derived electric and magnetic units depend. Three methods of realising the ampere are as follows:

- By using Ohm's law, the relation $A = V/\Omega$ and using practical realizations

defined in terms of h and the charge of the electron, e. Those are extremely small quantities, yet both are manifest in measurable macroscopic phenomena.

Current in a Kibble balance is measured by way of a resistor in the circuit. Resistance can be determined to about 1 part per billion using the von Klitzing constant, which describes how resistance is quantized (has specific numerical values) through a phenomenon called the quantum Hall effect.

Voltage is measured using the Josephson effect (and its associated Josephson constant), which relates to frequency in a superconducting circuit, with measurement uncertainties in the range of 1 part in 10 billion. The Josephson effect is the world's *de facto* standard for quantifying voltage.

Because of these connections to the Planck constant, a Kibble balance can measure h when the mass is exactly known (as in the case of a 1 kg standard), or it can measure an unknown mass if h is exactly known.

The redefinition of the kilogram has assigned a specific fixed value to h, allowing Kibble balances to measure mass without recourse to the IPK or any physical object.

The New SI Definitions

of the SI derived units the volt and ohm, based on the Josephson and quantum Hall effects.

- By using a single electron transport (SET) or similar device, the unit relation A = C/s, the value of e given by the definition of the ampere and a practical realization of the SI base unit of the second, s. At present, single electron transport implementations have technical limitations but these can be expected to improve in the future.
- By using the relation I = C dU/dt and the relation A = F V/s, and practical realisations of the SI derived units the volt V, the farad F and the second s.

The coulomb is realised by a known current in amperes and a measured time interval in seconds.

The volt V can be realised using the Josephson effect and the following value of the Josephson constant
K_J = 2e/h = 483,597 848 416 984 THz V^{-1}

This value is used to 15 significant digits (more could be used if required).

The Josephson voltage standard is a complex system that uses a superconductive integrated circuit chip to generate stable voltages that depend only on an applied frequency and fundamental constants. It is an intrinsic standard in the sense that it does not depend on any physical artefact.

It is the most accurate method to generate or measure voltage and, by international agreement in 1990, is the basis for voltage standards around the world.

Specifying accuracy to 15 significant digits is extraordinary - on the circumference

of the Earth this would be a precision to 40 nanometres - within than the wavelength of extreme UV light. The measurement scientists certainly do not do anything by 'rule of thumb'.

The Ohm Ω unit of resistance can be realized as follows:

- By using the quantum Hall effect in a manner consistent with the CCEM Guidelines and the following value of the von Klitzing constant: RK = 25 812,807 459 3045 Ω = h/e^2
  Klaus von Klitzing is known for his discovery of the integer quantum Hall effect for which he was awarded the 1985 Nobel Prize in Physics. The inverse of the constant gives the value of the conductance quantum.
- By comparing an unknown resistance to the impedance of a known capacitance by using, for example, a quadrature bridge, where for example, the capacitance has been determined by means of a calculable capacitor and the value of the electric constant given by $\varepsilon_0 \mu_0 c^2 = 1$.
  Realising the ohm also realises the unit siemens S which is its inverse.

The original value of the magnetic permeability of space μ_0 was defined as:
$4\pi \times 10^{-7}$ = 12,566 370 614 359 1… $\times 10^{-7}$ H/m. This gives the value of the electric permittivity ε_0 of space from the Maxwellian $\varepsilon_0 \mu_0 c^2 = 1$. When the new SI system is implemented in May 2019, with an exact value of ε_0, μ_0 must be experimentally determined. A value of $4\pi \times 1,000\ 000\ 000\ 82\ (20)\ 10^{-7}$ H/m has recently been measured. It is proportional to the dimensionless fine structure constant 'α' with no other dependencies. Astrophysicists have suggested that the fine structure constant can vary slightly in other

parts of the Universe. The value of the fine structure constant is important. If it were different by 4%, carbon not be produced in stellar fusion, and if it were greater than 0,1 stellar fusion would not occur at all leaving a universe consisting of nothing but hydrogen.

The value of the von Klitzing constant RK adopted by the CIPM in 1990 was larger than the present value by 17,793 x 10^{-9} (an extremely small amount).

The farad F unit of capacitance can be realized as follows:

- By comparing the impedance of a known resistance obtained using the quantum Hall effect and the value of the von Klitzing constant, including a quantized Hall resistance, to the impedance of an unknown capacitor using, for example, a quadrature bridge.
- By using a calculable capacitor and the value of the electric constant $\varepsilon_0 = 1/\mu_0 c^2$.

The henry H unit of inductance can be realised as follows:

- By comparing the impedance of an unknown inductance to the impedance of a known capacitance with the aid of a known resistance using, for example, a Maxwell-Wien bridge, where the known capacitance and resistances have been determined, for example, from the quantum Hall effect and the value of RK.
- By using a calculable inductor of, for example, the Campbell type of mutual inductor, and the value of the magnetic constant μ_0.

The tesla T unit of magnetic flux density can be realised as follows:

- By using a solenoid, Helmholtz coil or other configuration of conductors

of known dimensions carrying an electric current determined in terms of the realized ampere and the value of magnetic constant μ_0 in the calculation of the magnetic flux density generated by the current carrying conductors.

- By using nuclear magnetic resonance (NMR) with a sample of known gyromagnetic ratio, for example, a spherical sample of pure H_2O at 25°C and the most recent recommended value of the shielded gyromagnetic ratio of the proton y'_p given by CODATA.

The unit metre has come a long way since the metric system was given Royal approval on 30 March 1791. The metre was defined as one ten millionth of the meridian from the North Pole to the equator and passing through Paris. Even at this early stage it was deemed appropriate to derive the units from natural phenomena. The unit of length from the dimensions of the Earth and the unit of mass from the density of water.

The distance from Dunquerque through Paris to Perpignan was triangulated in 1740 and then from Perpignan to Barcelona in 1792. From these measurements the metre was calculated and over the years standard prototypes made. The unit of length in France before the metre was the *toise*.

The *toise* was divided in 6 pieds (feet) or 72 pouces (inches) or 864 lignes (lines) in France and used until 1812.

In 1799 the metre was defined to be exactly 443,2960 *lignes*, with the intention that the metre should equal 1/10 000 000 of the distance from the pole to the equator. This had the effect of making the *toise* = 1949,03631 mm.

With this major SI landmark in measurement science achieved, it seems unlikely that any further development of unit definitions will be required in the foreseeable future, however much further R&D may be required in the *Mise en Pratique* for the realisation of the units for the achievement of the required precision.

Further development of single electron transport could well bring major advances to measurement precision. **wn**

DEHN protects AFRICA

DEHNconcept
Concepts and designs for lightning and surge protection systems

Developed concepts for lightning protection systems of complex installations in line with the IEC 62305 standard (SANS 62305) include drawings, mounting details, bills of material, specification texts (tender texts), concept descriptions and material offers. To develop a professional concept, a risk assessment must be conducted. From the risk assessment, a lightning protection level (LPL) is derived, and the applicable protection methods are then used to design a lightning protection system (LPS).

Our services include:
- Soil resistivity and earth resistance surveys
- Risk assessments as per IEC/SANS 62305-2
- Site assessment surveys
- In-depth 3D detailed lightning protection designs, which include detailed mounting drawings and cost-optimised bill of materials
- Basic tender concept designs with estimated Bill of materials
- Earth-termination system designs for lightning protection systems
- Earth-termination system simulations and designs for calculating safe power frequency step and touch potentials
- Calculation of separation distances as per IEC/SANS 62305
- Consulting of specification writing
- Technical engineering support of surge protection devices, external lightning protection and earthing products.

DEHN AFRICA (Pty) Ltd
+27 (0)11 704 1487 | info@ dehn-africa.com
www.dehn-africa.com

Our Expert Answers

Power transformers are subject to several stresses and changes in their operational life, so that they will eventually deteriorate to the point that it fails or must be replaced. Power transformer maintenance allows this aging process to be quantified and tracked to avoid failures. Utilities and service companies schedule power transformer maintenance programs to assess their condition, increase its service life, and provide safe and trouble-free operation.

QUESTION ONE:

Is it important to service and maintain distribution and power transformers?

ANSWER ONE:

Yes, it is! A good maintenance programme, as well as a comprehensive plan, can prolong the life of your equipment. The best way to achieve this is through interaction with the transformer Original Equipment Manufacturer (OEM) who would be able to recommend the most appropriate maintenance and service plan for the respective equipment. This would include inspection reports, thermal imaging and oil analysis, amongst other activities.

An inspection report will document the current status of the equipment providing a baseline for future maintenance requirements. It is always essential to undertake a visual inspection as this assists in identifying oil leaks and detecting broken or damaged seals or components that may contribute to premature failure.

Oil analysis is a critical aspect of both maintenance and servicing on transformers as it will provide accurate data which then enables an informed decision as to what steps to take. Oil analysis focuses on a variety of aspects including moisture content and acid concentration. Monitoring of gas formation within the oil is vital as this will indicate the start of a problem.

Thermal imaging should form part of a maintenance programme as this will allow the identification of abnormalities (hot spots) that could be related to poor connections or contact between conductive parts.

QUESTION TWO:

What are the most common items that should be checked during the service?

ANSWER TWO:

Transformers that have been in service for a few years will have accumulated dirt and dust, and this 'pollution' - as it is referred to - will eventually contribute to equipment failure. Cleaning the equipment is considered one of the most basic yet essential items that should be attended to and this must include the contacts of protection devices to ensure functionality.

When transformers are kept clean, it is far easier on visual inspection to identify any issues such as oil leaks or broken parts. An example would be where the skirt of a bushing has been damaged or broken, and pollution then reduces the creepage distance to earth.

As mentioned above, an oil sample should be taken, and it is essential that a competent, skilled individual does this, and that the sample is sent to a reputable laboratory for analysis. All the oil analysis tests serve a different purpose, and the sample should be tested for water content, breakthrough voltage, acid content and dissolved gas analysis (DGA). The content of Polychlorinated Biphenyls (PCB) should also be checked and reported.

All these aspects must be reviewed and considered to enable an adequately informed recommendation for a maintenance plan.

QUESTION THREE:

How often should a transformer be maintained and serviced?

ANSWER THREE:

It is recommended that transformer maintenance is conducted annually and this will ensure that the end-user comply with all mandatory safety and OHS Act requirements. While it is the owner or end user's responsibility to ensure that the equipment does not deteriorate to a state of risk to the environment, company or employees, this is not often done due to other more pressing issues.

For this reason, it is always recommended that OEMs be engaged to provide at the very least an annual inspection with associated repair and maintenance. However, it is not uncommon to implement maintenance programmes with six-monthly checks. This means that when a potential issue is encountered, this can immediately be addressed with suitable action by competent OEM personnel.

QUESTION FOUR:

What is the benefit of on-site maintenance and repairs?

ANSWER FOUR:

The most important benefit is derived when an OEM is contracted to undertake this work as this ensures quality workmanship. Most transformers are equipped with safety devices to prevent serious or sustained fault conditions which could lead to catastrophic failures and damage to more than just the equipment.
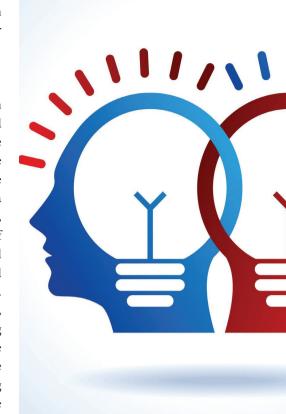
It is essential to inspect and maintain such instrumentation to ensure accurate monitoring of the transformer, and this should form part of the maintenance programme. A proactive approach to maintenance allows minor repairs to be done as and when required, preventing costly unscheduled downtime with associated production losses.

QUESTION FIVE:

What is the expected outcome when a transformer is sent in for repairs or rewinding?

ANSWER FIVE:

The most critical step is first to ascertain if it is economical to repair and rewind a transformer. Transformers should be sent to a reputable OEM who has the necessary expertise to strip and assess the state of the transformer before making a recommendation. During this process, visual assessment, as well as a series of electrical tests and data collection, will allow the cause of failure to be determined and appropriate action to be recommended. Reasons can vary from end-of-life, lightning, spikes and surges to overloading and poor maintenance. Rewinding, for the most part, is the process of replacing the coils and all insulation and reassembling the transformer ensuring that it will operate within the original parameters (losses and impedance). **wn**

March in History

March is the third month of the year in both the Julian and Gregorian calendars. It is the second of seven months to have a length of 31 days. In the Northern Hemisphere, the meteorological beginning of spring occurs on the first day of March.

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

1 MARCH

1966   It is thought the Soviet unmanned space probe Venera 3, crashed into the night side of Venus. Unfortunately, all its communication systems had failed before then. If the crash did happen, Venera 3 became the first spacecraft to land on another planet.

2 MARCH

1972   NASA launched the Pioneer 10 spacecraft on a mission to explore the outer planets of the solar system. It passed near Jupiter and Neptune before leaving the solar system. After that, Pioneer 10 became the first of five artificial objects to achieve the escape velocity that would allow them to leave the Solar System. The last contact with Pioneer 10 was January 2003.
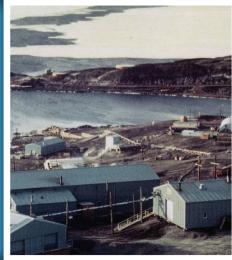
3 MARCH

2018   South Africa earned a new Guinness World Record when a team, representing Clover brand Cream O'Naise, broke the record for the world's longest line of sandwiches by constructing a sarmie-feast that measured a whopping 4,004.43 metres.

4 MARCH

1962   The United States' Atomic Energy Commission announced that the first (and only) atomic power plant in Antarctica, the PM-3A, Naval Nuclear Power Unit, went critical and supplied power to the McMurdo Research Station. During its 10-year lifetime, the nuclear power station produced over 78 million kilowatt hours of electricity and created 13 million gallons of fresh water using the excess steam in a desalination plant. Though this device reduced the necessity for fuel imports, it was plagued with problems.

ENGINEERING
"IF YOU'RE NOT TIRED, YOU'RE NOT DOING IT RIGHT."

5 MARCH

1558 Smoking tobacco was introduced for the first time in Europe by Francisco Fernandes. It was believed to cure anything from chronic diseases to minor aches and pains.

6 MARCH

2015 NASA's spacecraft, Dawn, entered orbit around the dwarf planet, Ceres, at 7:39 EST. The 7½ year journey of 4,900 million km was made with steady acceleration from ion propulsion. It became the first spacecraft to orbit a dwarf planet.

7 MARCH

1897 Dr John Kellogg served the world's first cornflakes to his patients at a sanatorium in Battle Creek, Michigan, USA. These were an unsweetened addition to the diets of his patients, who suffered from a variety of ailments, which he believed could be cured by a strict vegetarian diet and vigorous exercise. In 1906, his brother, Will Keith Kellogg, added sugar to the recipe and began marketing them as a breakfast food. Dr Kellogg so thoroughly disapproved of this development that he sued Will in a fruitless attempt to keep the Kellogg name off of the mass-produced breakfast cereals.

8 MARCH

1950 The Volkswagen Type 2 Microbus went into production. It is a forward control panel van that was introduced by the German automaker Volkswagen as its second car model. Following the Type 1 (Beetle) – it was given the factory designation Type 2. Brazil had the last factory in the world that produced the T2 series of Type 2, which ceased production on 31st December 2013, due to the introduction of more stringent safety regulations in the country.

9 MARCH

1611 Johannes Fabricius, a Dutch astronomer, observed the rising sun through his telescope and observed several dark spots on it. This is thought to be the first-ever observation of sunspots.

10 MARCH

1923 Sir Ronald Ross, the authority on tropical disease, told the British Science Guild in London: *"You throw your geniuses in the dust heap."* He pointed out that the man who discovered methods of vaccination against cholera (Waldemar M. W. Haffkine) and the man who found the cure for sleeping sickness (Sir David Bruce) were no longer employed in Great Britain.

11 MARCH

105 Ts'ai Lun invented paper, made from bamboo, mulberry, and other fibres, along with fishnets and rags. He lived and served as an official at the Chinese Imperial Court at the Han Dynasty in China. He presented samples of paper to Emperor Han Ho Ti. He was promoted by the Emperor for his invention and became wealthy. In China, before Tsai, Lun, books were made of bamboo, which was heavy and clumsy. Some books were made of silks, which were very expensive. In the West at that time, books were made of sheepskin or calfskin.
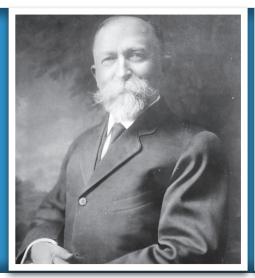
12 MARCH

1820 The Royal Astronomical Society (UK) was founded when 14 gentlemen met in the Freemasons Tavern, London and agreed to establish the Astronomical Society of London. It received its royal charter from King William IV on 7 March 1831.
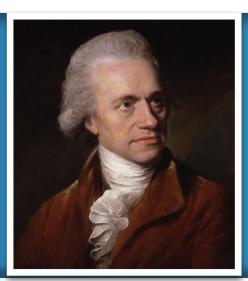
13 MARCH

1781 English astronomer William Herschel detected Uranus in the night sky, but he thought it was a comet. It was the first planet to be discovered with the aid of a telescope.

March in History

14 MARCH

2004   The largest cycling race at the time had 31,219 finishers and was the 2004 Cape Argus Pick 'n Pay Cycle Tour in Cape Town, South Africa. The race was entered by 42,614 cyclists. The tour had humble beginnings, with only 525 entrants and 446 finishers in its inaugural 1978 running. The 2011 edition of the race capped the number of entrants at 35,000.

15 MARCH

1806   A 6 kg chondrite meteorite - carrying carbon-based, organic chemicals - was unequivocally identified for the first time. It was seen 'arriving' on earth at 5:30 pm, outside Alais, France. The organic chemicals it carried suggested the possibility of life on whatever body was the source, somewhere in the universe. According to Swedish chemist, Jöns Jacob Berzelius's observations, it "emits a faint bituminous substance" when heated.

16 MARCH

196   The Gemini VIII capsule, piloted by David Scott and Neil Armstrong, successfully docked with an unmanned spacecraft, the Agena Target Vehicle.

17 MARCH

1898   John Holland ('the father of the modern submarine') demonstrated the first practical submarine off Staten Island in New York, USA for 100 minutes. Holland's sub was not the first underwater boat but is credited as the first practical one.

18 MARCH

1974   Atari Introduced Gran Trak 10, the first arcade game to use a solid-state read-only memory (ROM) to store sprites for each car, the game timer, the race track, and the score. As such, it was the first game to have defined characters rather than mathematically manipulated dots. The game's controls, which include a four-position gear shifter, a steering wheel, and two-foot pedals, were also all firsts for arcade games.

19 MARCH

2018   The world lost the last male northern white rhinoceros, aged 45. Sudan was survived by Najin, his daughter, and granddaughter, Fatu, who became the last two remaining rhinos of the subspecies on Earth. Physical problems have prevented females from carrying young. Using in-vitro fertilisation, perhaps the subspecies can still be regenerated. Poachers have caused the extinction of the subspecies in the wild.

20 MARCH

1900   Nikola Tesla received a patent for the wireless transmission of electric power.
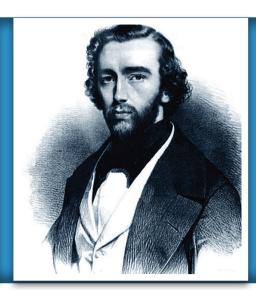
21 MARCH

1846   Adolphe Sax applied for a French patent on his new instrument, the saxophone, which was granted on 22 Jun 1846 (No. 3326).

19??   *Our Janey's birthday - Happy Birthday!! - ED*

22 MARCH

1992   England beat South Africa in rain-ruined cricket World Cup semi-final.

23 MARCH

1840   Englishman John William Draper took the first successful photo of the Moon. He made a daguerreotype (image on a silvered copper plate), a precursor of the modern photograph.

24 MARCH

2001   Mac OS X 10.0, the first public version of Mac OS X, was released. The code name for this release was Cheetah, although Apple did not start using the code names for marketing purposes until Mac OS X 10.3, Jaguar.

25 MARCH

1857   Frederick Laggenheim took the first photograph of a solar eclipse.

26 MARCH

1935   Scottish physicist Robert Watson-Watt, considered by many to be the inventor of RADAR (RAdio Detection And Ranging), first demonstrate its feasibility. Watson-Watt had been experimenting using radio waves to locate thunderstorms and thought of the idea of using it to detect aircraft.

27 MARCH

2015   Soyuz TMA-16M was launched carrying three crew members to the International Space Station. Russian cosmonaut Mikhail Korniyenko and American astronaut Scott Kelly began a special year-long mission to test the effects of long-term habitation on the human body in space.

28 MARCH

1910   The first seaplane took off from Martigues near Marseilles, France, designed by Frenchman Henri Fabre.

29 MARCH

1980   The first transplant of a human fingernail was accomplished on a 12-year-old boy's thumb, using one of his own toenails in Strasbourg, France.
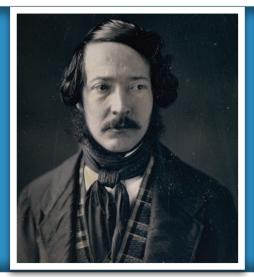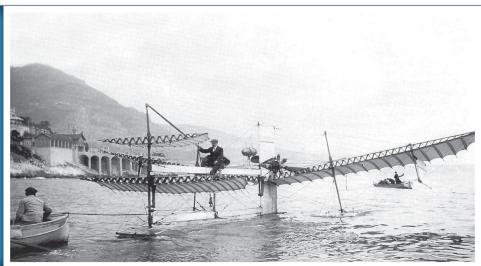
30 MARCH

1950   The invention of the phototransistor was announced. This was a transistor operated by light instead of electric current, invented by Dr John Northrup Shive of the Bell Telephone Laboratories at Murray Hill, New Jersey, USA.

31 MARCH

2003   Britain's Calder Hall nuclear power station was closed at the end of almost 47 years of service since it was opened on 17 Oct 1956. It was the world's first commercial nuclear power station that was connected to a national electricity grid. **wn**

SAIEE CENTRES

Bloemfontein Centre
Chairman | Dr Kanzumba Kusakana
T|051 507 3088 **E**|kkusakana@cut.ac.za

Eastern Cape Centre
Chairman | Jacques van der Heide
T|041 404 3326 **E**|vdheidj@eskom.co.za

Gauteng Central Centre
Chairman | Lehlohonolo Mashego
E|mashegol@gmail.com

Kwa-Zulu Natal Centre
Chairman | Zola Ntsahngase
T|(033) 347-0000 **E**| zola@zmlafrica.co.za

Mpumalanga Centre
Chairman | Louis Kok
T|017 619 2607 **E**| louis.kok2@sasol.com

Northern Cape Centre
Chairman | Ben Mabizela
T| 073 708 0179 **E**| MabizeBG@eskom.co.za

Southern Cape Centre
Chairman | Johann Swanepoel
T| 0448714925 **E**|jgfswanepoel@gmail.com

Vaal Centre
Chairman | Martinus Beumer
T|083 256 7177 **E**|martinus.beumer@proconics.co.za

Western Cape Centre
Chairman | Joyce Mtimkulu
T| 087 820 3555 **E**|joymtimkulu@yahoo.com

PMOC™

SOFTWARE APPLICATION

ADDITIONAL SERVICES

CONSULTING SERVICES

PROGRAMME & PROJECT MANAGEMENT

NETWORK INFRASTRUCTURE DEPLOYMENT

OPERATIONS CENTRE SERVICES (NOCDESK)

OPERATIONS INTELLIGENCE AS A SERVICE

MCORP
COMMUNICATIONS

BRINGING YOU TOMORROW'S DECISIONS - TODAY!

T I 011 477 5600 I info@mcorp.co.za I www.mcorp.co.za