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Praise for the weather lads and the scientists

Every so often I get a letter from an irritated reader who accuses me of being way too critical and way too judgmental about the work that the South African government is (or isn't) doing. These readers are offended by my cynicism and pick me out about it too – as they are most welcome to do.

But in my defence, I would like to say that when the government does something well then I am among the first to acknowledge their efforts and to praise them for the steps they have taken. And this month, I believe that the South African Weather Service and the Public Works Department need special praise for the work that has been done at Marion Island.

I also believe that the Department of Science and Technology needs praise for the investment that it is making in South Africa's scientific and technological future through organisations such as the CSIR and the National Research Foundation (NRF).

Why, you might ask, would I want to praise the weather lads and the scientists?

First of all the new scientific base at Marion Island – built at a cost of R200-million – is a tribute to the construction work done by the Public Works Department over almost eight years.

Work on the new science centre started in 2003 and provides accommodation for up to 80 people – although most of the time there are only 12 people living there – has three modern scientific laboratories, new kitchen and dining areas and a cross-section of other specialised buildings, including a gym, sauna and whirlpool for the residents.

Building the base station cannot have been easy given the fact that all materials and equipment had to be lugged across the treacherous Southern Atlantic Ocean by the SA Agulhas and then, using a heavy-duty helicopter, airlifted onto the shore where it was used for construction of the new premises.

That in itself is an achievement but when you add miserable working conditions to the mix, the new base station really stands out as a tribute to the determination of a few dedicated and determined people.

Just as the laser technology developed and applied by the CSIR is a tribute to work that both the CSIR and the Department of Science and Technology are doing. The CSIR has set up its National Laser Centre (NLC) where a 5,0kW carbon dioxide laser is used to demonstrate a production run of an undercarriage component for BMW.

The NLC – and the materials processing group under which it falls – was set up just ten years ago to support South African industry in implementing laser technology. This unit is the most interactive unit of its kind in the South African industrial community and it's doing exceptional work in terms of the laser technology and materials processing.

How many people are aware of this and how many people – like me, who are sometimes critical of government – need to acknowledge the good work that is being done in so many different spheres.

When it comes to meritorious achievements – such as those at Marion Island and at the CSIR – then I believe that the achievers have every right to boast about what has been done and to sing about their own achievements with the gusto that these deserve.

The more I look into scientific and technological advances in South Africa the more heartened I become because the combination of dedicated private sector companies working alongside the Department of Science and Technology – with its pitifully small budget – augers well for the future of South Africa.

And for that the government needs and deserves our earnest praise.

Paddy Hartdegen - Editor
paddyh@crown.co.za

Editor
Paddy Hartdegen
paddyh@crown.co.za

Design & Layout
Duncan Stevens

Published monthly by
Crown Publications cc
2 Theunis Street
Bedford Gardens
Johannesburg
Tel: (011) 622-4770
Fax: (011) 615-6108
e-mail: crownmag@crown.co.za

Publisher
Jenny Warwick

Deputy Publisher
Karen Grant
crownmag@crown.co.za

Technical Advisor
Ian Jandrell, PrEng, PhD

Advertising Manager
Veronica Breedt
veronicab@crown.co.za

Circulation and Subscriptions:
Norma Massey
normam@crown.co.za
R240 (incl. Vat) per annum
Postage extra outside RSA

CROWN PUBLICATIONS

All enquiries for WattNow:
P O Box 140
Bedfordview, 2008

All enquiries for SAIEE:
P O Box 751253
Gardenview, 2047
crouchm@saiee.org.za

SAIEE
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ISSN: 1991-0452

Printed by: Shumani Printers, Cape Town

WATT'S

WATT'S HAPPENING

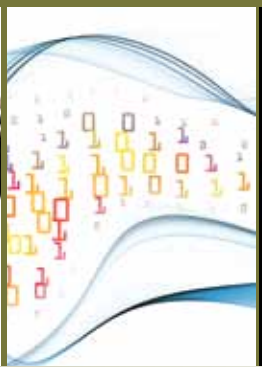
1> Editor's Comment
Government's good work in many spheres needs to be acknowledged.

10> "Tea. Earl Grey. Hot."
A three-dimensional object can be produced through the process of laying down successive layers of material. Originally these printers were expensive and used for prototyping new designs and components. Gavin Chait explains that they are now sufficiently cheap, reliable and capable to be used to produce production-ready products.

32> Laser and laser based manufacturing
The Materials Processing group of the CSIR's National Laser Centre (NLC) held an open day to illustrate what laser technology can do for South African manufacturers and to showcase the group's achievements in the 10 years since its inception. Peter Middleton reports.

20> Watt's Green
Vehicle manufacturers from Japan and Europe have embarked on major investments in research, development and commercialisation of electric vehicles for the future. Paddy Hartdegen discusses developments by some of the largest brands in the world.

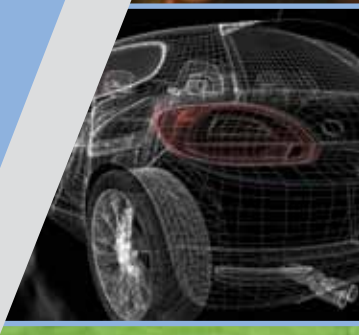
43> Watt Says
A selection of letters from our readers: some are sardonic and critical, others amusing and light-hearted.




4> WATT'S GOING ON?

Luther to Libya - the revolution will be Twittered; Why data is the new oil; Forget ride-on mowers, get a robot; SEW opens drive academy.


45> SAIEE

Engineering the future: Relevance of the SAIEE in our contemporary times; Meet Andries Tshabalala; Knysna Turbine Hotel; SAIEE courses.

INSTITUTE PAGES

INSIDE

23> WATT'S TECHNOLOGY

Satisfied with speeds if you're lucky; A touching tale; Fit your hearing aid onto your molars; Long live Discovery; Japanese quake shuts major factories; Code protection doesn't extend to theft; Hackers hack into security tokens.

16> WATT'S SCIENCE

SA's newest weather station on a rock; Japan meltdown, nuclear fears widespread; Orbit or Abort; Earthquakes are just a viscous cycle; LHC resumes work after shut-down.

37>

WATT'S ENERGY

Can back-up systems handle future growth; Back-up batteries that run on air; MV substation on a truck; Turn to the seas for energy; Big boost for Eskom wind, solar plants.

ABC Certified
Total Paid Circulation 25, Total Free 3770, Total Circulation 3795
July - September 2010

Luther to Libya

the revolution will be Twittered

By Gavin Chait

Thus, we hold, then, that man is justified without the works of the law to do, alone through faith."

The words caused a revolution. 'Alone' was pivotal. What the writer appeared to be saying is that individuals could choose their own paths based on their own interpretation of the law. Ordinarily an obscure writer in an obscure town wouldn't be heard. But change had come.

Martin Luther's German translation of the Bible coincided with the German Johannes Gutenberg's invention of the mechanical movable type printing press. Gutenberg's Latin version of the Bible was printed in the 1450s. By 1522, printing presses were more common and Luther could afford to self-publish his gospels. There had been previous German translations but the printing press allowed Luther's to be disseminated rapidly and cheaply.

"Luther's New Testament was so much multiplied and spread by printers that even tailors and shoemakers, yea, even women and ignorant persons who had accepted this new Lutheran gospel and could read a little German, studied it with the greatest avidity as the fountain of all truth. Some committed it to memory, and carried it about in their bosom. In a few months such people deemed themselves so learned that they were not ashamed to dispute about faith and the gospel not only with Catholic laymen, but even with priests and monks and doctors of divinity," moaned German humanist and controversialist, Johann Cochlaeus.

Hans Lufft, a renowned Bible printer in Wittenberg printed over one hundred thousand copies between 1534 and 1574, which went on to be read by millions.

The early church was an autocracy. Interpretation of the scriptures was the reserve of the Catholic hierarchy. Many clerics were illiterate and ensuring that the gospels remained published only in Latin excluded the majority from accessing them.

However, Luther's Bible coincided with a rapidly expanding merchant class. The merchants were an aspirant bunch, sending their children to the new universities and promoting regional culture and preferences. An emerging nationalism was taking hold built around the vernacular languages, German, Dutch, Italian and French.

The Pope financed Catholic power by demanding tithes from the faithful; tithes that stripped the power from the regions by draining their wealth. The Pope's chief justification for this was his hold on interpretation of the scriptures. Luther had called that into question. And everyone could read precisely what it was that was there.

The Papacy would never recover. The printing press was to the 15th century what the Internet is to our time; revolutionary and disruptive. Disruption is never welcome to the established elite. Johannes Trithemius, an abbot and otherwise very learned man, was particularly incensed by how mass production of books would reduce people's respect for the work.

"[The writer,] while he is writing on good subjects, is by the very act of writing introduced in a certain measure into the knowledge of the mysteries and greatly illuminated in his innermost soul; for those things which we write we more firmly impress upon the mind ... While he is ruminating on the Scriptures he is frequently inflamed by them."

In fact, throughout history, many of the most learned scholars of their times have railed against new innovations (even as they made use of them – Trithemius was content to have his books mass produced on a press).

The November 1889 issue of Nature featured an article by Charles Hallock on 'Nature's revenge on Genius':

"The telephone is the most dangerous of all because it enters into every dwelling. Its interminable network of wires is a perpetual menace to life and property. In its best performance it is only a convenience. It was never a necessity ... Instead of permitting its introduction into houses indiscriminately, telephone stations might be established, when

desired, to embrace districts of six blocks square, thirty-six blocks inclusive, through which messages may be transmitted. It is seldom that there are cases of such urgency to customers as to make the extremest distance within the district a hardship to travel."

This was neatly followed in October 2010, by the following in the Smithsonian: "As a teacher of journalism, I tell myself that all this connectedness is the link that joins the Family of Man. But in my quieter moments (of which there are now not many), I see we've created a nation of zombies—heads down, thumbs on tiny keyboards, mindless millions staring blankly, shuffling toward some unseen horizon. To them, the rest of us are invisible."

So, is it merely an idea whose time has come, or is it the medium itself? One Cairo resident summed up his attitude: "We use Facebook to schedule the protests, Twitter to coordinate, and YouTube to tell the world."

Perhaps. But Egypt shut down the Internet and Libya doesn't have it. The Berlin Wall fell in 1989 even though the Internet hadn't yet been invented and Tiananmen Square ended in slaughter that same year.

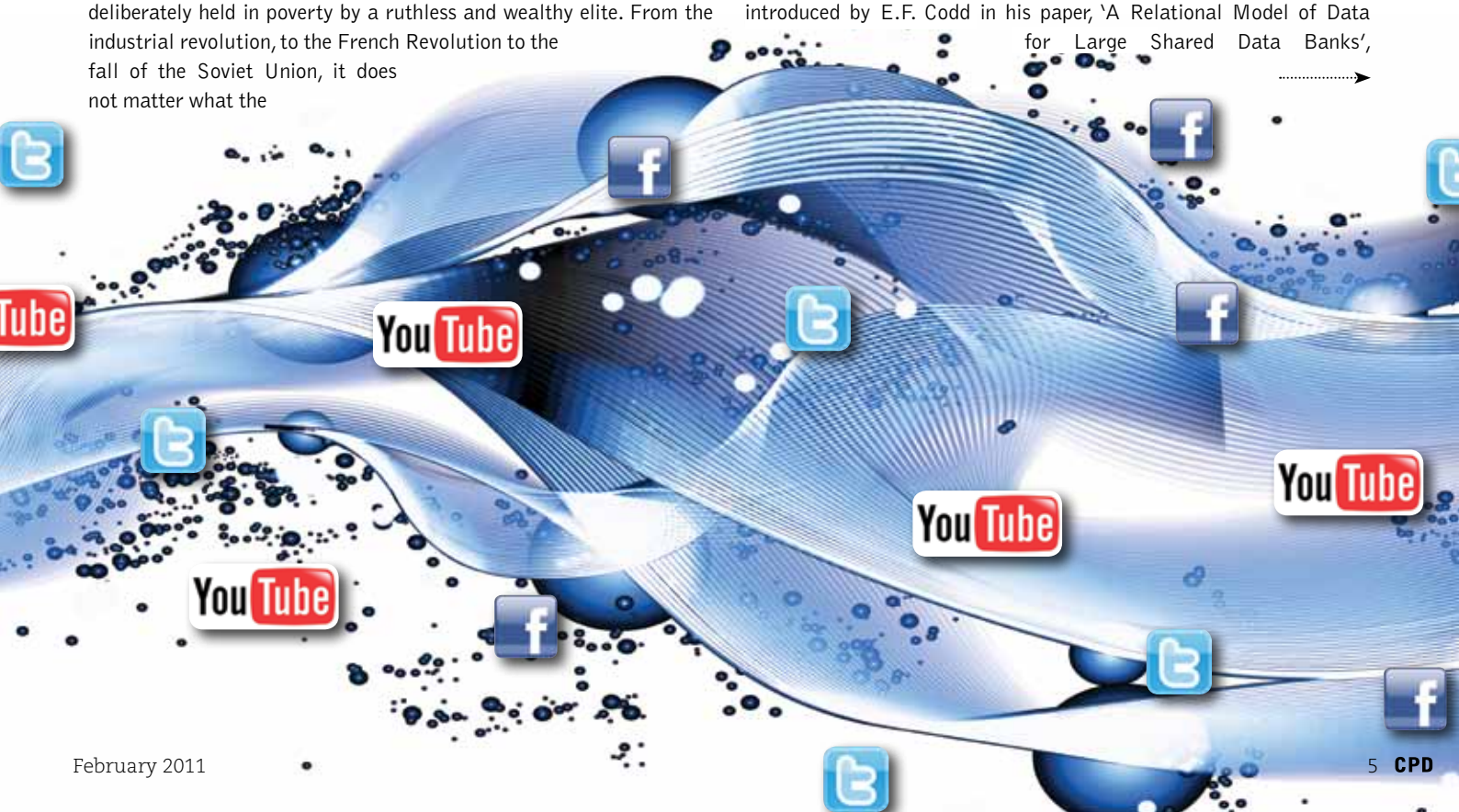
The real driver of social change throughout history has been consistent. A large, young and fast-growing urbanised population, deliberately held in poverty by a ruthless and wealthy elite. From the industrial revolution, to the French Revolution to the fall of the Soviet Union, it does not matter what the politics, economics or religious make-up of the society. What is true is that these huddled masses yearning to breathe free will use whatever mechanisms are available in order to communicate and agitate.

So what is Social Media and how is it used?

Given their current popularity, it may be difficult to remember that Facebook, Twitter and YouTube only started in the past five years. None are 'original'. For Facebook, think social clubs, for Twitter, think SMS, for YouTube, think 'family videos'. What is different is that the complexity of production has been reduced. For Twitter, deliberately forcing users to produce only 140 characters has been a bonus. Most conversations are short spurts, not lengthy speeches. Let's be honest, few people can string a lengthy article together every single day.

So, how does one go about building infrastructure that permits 190 million users to generate 65 million tweets a day?

Back in 1876, Melvil Dewey invented his eponymous Dewey Decimal System now used to organise the world's libraries. Where a really big library may have up to a million books, Google indexes billions of pages. Initially this was organised in relational databases, usually SQL or some proprietary system based on twelve rules first introduced by E.F. Codd in his paper, 'A Relational Model of Data for Large Shared Data Banks',



published in 1970. The key problem here is that a database is really just a structured set of tabular data stored on a hard-drive. Any call to the data requires physical parsing of the tables via the database layer. This can be tremendously slow, more so when one is considering billions of items accessed millions of times a day.

In 2006, Google published 'Bigtable: a distributed storage system for structured data'. In 2007, Amazon published 'Dynamo: Amazon's highly available key-value store'.

A relational database requires a schema – a system of data organisation – before data can be inserted. These codify the relationships between the data. Any required changes can rapidly become inefficient. Worse though, "It is difficult to create redundancy and parallelism with relational databases, so they become a single point of failure," says Alex Iskold of ReadWriteWeb.

Google and Amazon are abandoning structured relational database management systems in favour of a loosely-organised weighted graph of key-value pairs.

There are a number of approaches to this. Document databases allow data to be distributed across multiple computers. Each of these partitions is known as a shard (and the process is known as 'sharding'). Document databases shard easily because there are no explicit references between documents.

A Map/Reduce process allows parallel processing of all the documents in the database. Map applies a function to every document in the database while Reduce applies a function to a set of grouped results of the map.

Document databases work well where you already know what you're looking for. Traversal of such a graph can be extremely slow, however. Graph databases attempt to mediate this by storing objects (vertices) connected by an edge which defines their relationship. This permits optimisation for traversal algorithms. However, graphs – again, because of the imposition of some structure – do not scale as well as document databases.

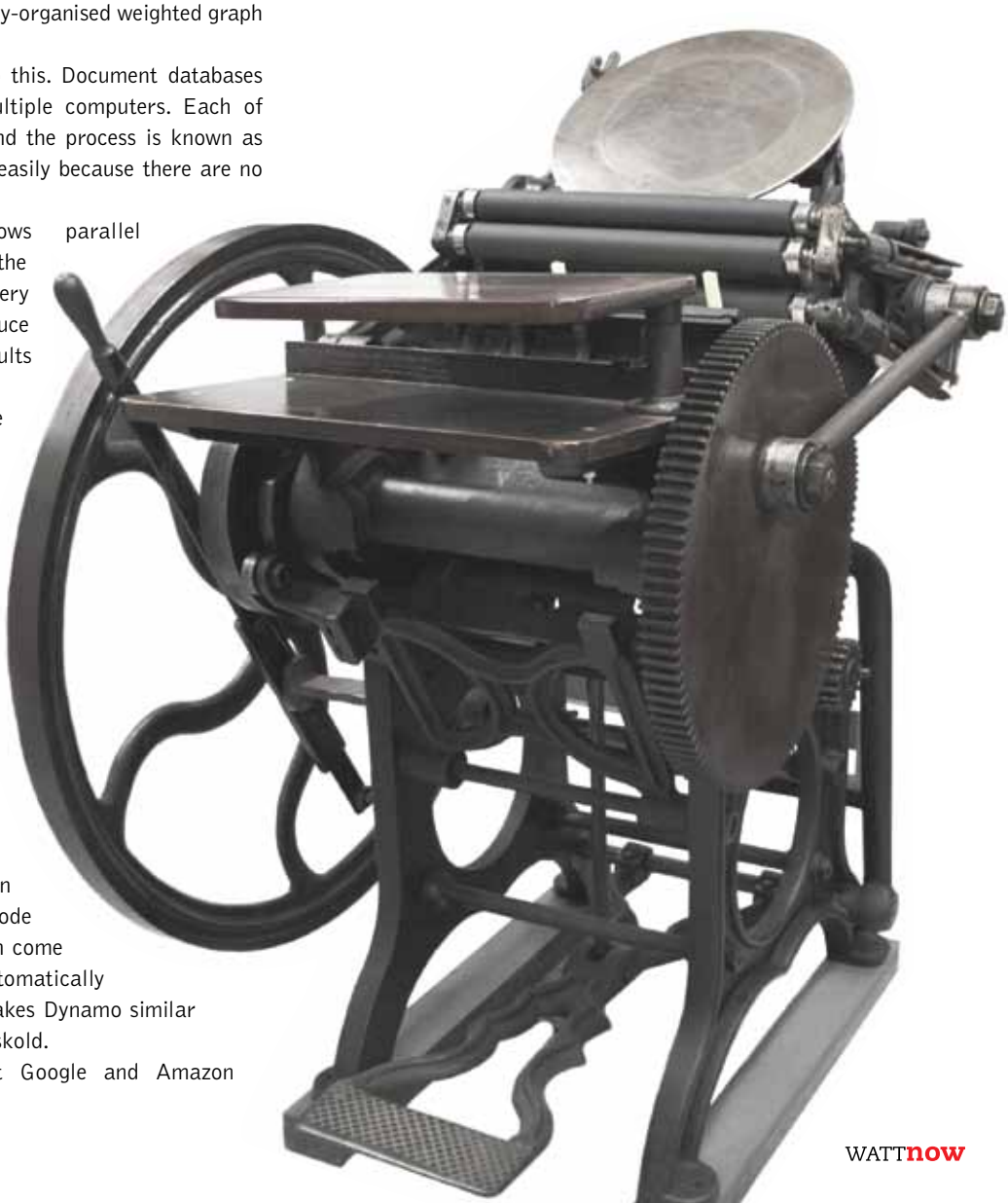
"So Dynamo is quite complex, but is also conceptually simple. It is inspired by the way things work in nature – based on self-organisation and emergence. Each node is identical to other nodes, the nodes can come in and out of existence, and the data is automatically balanced around the ring – all of this makes Dynamo similar to an ant colony or beehive," concludes Iskold.

The Apache foundation couldn't let Google and Amazon dominate Internet architecture with proprietary systems. In 2008 Yahoo! became the first commercial implementation of Apache's Hadoop Distributed File System.

Hadoop is based on Apache's Unstructured Information Management Architecture (UIMA), 'a component software architecture for the development, discovery, composition and deployment of multi-modal analytics for the analysis of unstructured information and its integration with search technologies', initially developed by IBM. The source code for a reference implementation of this framework has been made available on the Apache Software Foundation website.

This is a fast-growing area of development. Even Twitter 'Failwhale' causes pandemonium amongst users and regulators.

So, while the revolution may be tremendously chaotic, somewhere underneath is an engineer trying to make it all work.



Why **data** is the new **oil**

By Richard Mullins

Can there be any commodity more precious to an online marketer today than data? This resource is already valuable for those who know how to exploit it effectively and its value is set to grow even more over the next three years.

Data is the oil of the online world – the fuel that powers the engines of our online marketing and sales efforts. Yet there are many businesses that have yet to grasp just how important the reams of data generated by their customer relationship management systems, online ad campaigns, websites, search campaigns, email marketing efforts, and so on, will be to their organisations in years to come.

This is data that gives important insight into what targeted customers are searching for through the search engines, their demographics and interests, their browsing behaviour and much more.

By analysing this data, marketers can answer important questions such as which search terms are most valuable to their businesses, which cross- and up-selling techniques are most effective for their existing clients, and which messaging and environments are effective in converting new customers.

The data can enable companies to do effective remarketing - delivering ads to users that are known to have expressed an interest in the company's services or products. It can also be used to reactivate dormant customers through targeted offers or for customer retention strategies. Put simply, it is now possible to target the right customer at the right time with the right message.

However, many companies leave this invaluable data in the hands of multiple business partners without considering how these suppliers may use the data for their own benefit or what the implications of a breakdown in a key business partnership may be.

For example, many marketers outsource their search engine marketing or ad-serving to specialists in those fields without giving enough attention to data ownership issues. They may be shocked to find that an agency they work with has every right to aggregate and resell their campaign data to competitors. Be especially wary of free services – how exactly are they making money?

In an environment where marketers work with multiple agencies, simply understanding where all their data resides and what rights they have to it may be a challenge in itself. Who owns the data – the business, its marketing agency partner, the advertising network or the company that supplied the serving technology?

Marketers must start understanding these issues. They need to ensure that they have full control over and access to their data, even though they can still outsource the really technical stuff to a specialist. And they must put a sound web analytics environment in place so that they can leverage their data to build a more successful business.

The big winners in the online world are the companies that have access to rich data about their customers and know how to use it to drive sales. They understand that ownership of data is about ownership of customers. Those that don't own their data are just a step away from losing their customers.

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SEW EURODRIVE

Forget ride-on mowers, get a **ROBOT**

The days of using a lawnmower to get a bit of weekly (or should that be weakly) exercise are long gone with the many self-propelled models that are available throughout the world.

Now Husqvarna has gone one better by launching a robotic mower for small gardens and townhouse complexes. Known as the Automower 305, the new model is suitable for lawns up to 500m^2 in size and is equipped with lithium-ion batteries that will help to keep the lawn in perfect shape in virtually all seasons.

The robotic lawn mower weighs just 7kg making it especially suitable for townhouse complexes where the lawns are generally extremely small. It comes with a sophisticated anti-theft device, presumably to prevent it escaping or from being stolen in the middle of the night. The machine has an alarm and uses a personal identification number to activate it so if it is stolen it is virtually useless anyway. Husqvarna says that in future, robotic lawn mowers will be as common in homes as dishwashers or washing machines are today. Not only does the Automower cut the lawn, but it also fertilisers it while trimming.

It uses much less energy than an energetic (or idle) gardener and Husqvarna says it will complete a 500m^2 lawn using less energy than leaving a light bulb on for the time it takes the Automower to complete the task.

It's not cheap though. The Automower 350 costs €1 490 or R15 871. That's a lot of gardener's fees!

SEW opens drive academy

In response to customer requests for information about, and specifications for, SEW Eurodrive's range of products, SEW has launched a local drive academy.

According to Rene Rose, general manager communications, who will be responsible for running the academy, there is no doubt that the rapidly rising number of enquiries influenced the company's decision to set up a local drive academy, which is modelled on the very successful one based in Germany.

A number of training course are available immediately and more will be added in the future. Topics covered range from geared motor maintenance to condition monitoring, and training is practise orientated and demand specific.

"The courses do cover theory but the real benefit is that customers are able to practise using motors in actual applications," says Rose.

"With the skills shortages facing South Africa, people need to be trained on how best to use the machines and, more importantly, how to maintain them," says Rose.

An innovative aspect of the drive academy is that people who do in-house training are able to buy demonstration units from SEW for training purposes.

"This is particularly useful to other African countries where, quite often, the trainer will undergo a course and then transfer knowledge to the people who are operating the plant," says Rose.

"Tea. *Earl Grey.* **Hot.**"

By Gavin Chait

Jean-Luc Picard would pause momentarily at a non-descript, black-clad square slot in the wall of his office after issuing his command. A moment later a pot of Early Grey, brewed and ready to drink, would materialise.

The Star Trek replicator is a fiction. It could explain away plot holes, like "Where does all the air come from?" However, it isn't altogether impossible.

At its most basic, the replicator is a form of additive manufacturing as compared to the more familiar subtractive manufacturing. A three-dimensional object can be produced through the process of laying down successive layers of material. Originally these printers were expensive and used for prototyping new designs and components. They are now sufficiently cheap, reliable and capable that they are used to produce production-ready products.

"Three-dimensional printing makes it as cheap to create single items as it is to produce thousands and thus undermines economies of scale. It may have as profound an impact on the world as the coming of the factory did ... Just as nobody could have predicted the impact of the steam engine in 1750 – or the printing press in 1450, or the transistor in 1950 – it is impossible to foresee the long-term impact of 3D printing. But the technology is coming, and it is likely to disrupt every field it touches," says The Economist in 'Print me a Stradivarius', its February leader article.

Besides the commercial printers, there are also a number of open-source versions and a wide variety of approaches to printing.

Selective laser sintering (SLS) uses, for example, a carbon dioxide laser to fuse small particles of plastic, metal, ceramic or glass powders into three-dimensional shapes. The item is produced inside a powder-bed, with a pulse-laser focusing on a specific point until each layer is complete, whereupon the entire bed is lowered fractionally. SLS can use a wide variety of materials including nylon, polystyrene, steel, titanium and metal alloys, as well as composites and green sand.

As usual in these technologies, the US Defence Advanced Research Projects Agency (DARPA) was the principal sponsor and supported the work of Dr Carl Deckard at the University of Texas who patented the original process back in the mid-1980s. Unlike many other additive processes, the parts being built don't require support since they are entirely surrounded by unsintered powder within the manufacturing bed.

In 1989, Scott Crump invented fused deposition modelling (FDM) and founded Stratasys to commercialise his work. In FDM, a plastic filament or metal wire is unwound from a coil and run through an extrusion nozzle that is heated to melt the material. The nozzle is controlled to move in space by a set of stepper motors. During fabrication a water-soluble material is added to provide temporary supports to the structure and, after completion, these supports are dissolved by placing the item in a precisely heated sodium hydroxide solution. FDM has also received the open-sourced treatment by the RepRap project where the process is called fused filament fabrication (FFF). RepRap has released two 3D printing machines: Darwin, in March 2007 and Mendel, in October 2009.

All such printing is based on designs produced by Computer Aided Design and Manufacturing packages. As such, designs can simply be downloaded from the Internet. Dr Adrian Bowyer, a senior lecturer in mechanical engineering at the University of Bath in the UK, founded RepRap in 2005. His objective is that people can download the plans for his devices and that these devices can then replicate themselves. The device costs about $10 000 to buy.

The Guardian, a left-wing UK newspaper, breathlessly exclaimed: "[RepRap] has been called the invention that will bring down global capitalism, start a second industrial revolution and save the environment ..."

Stereolithography (SLA) uses a vat of liquid UV-curable photopolymer resin and a UV laser to produce its parts. The laser traces the part cross-section on the surface of the resin. The UV cures, solidifies and adheres the resin to the layer below it. As with sintering, a platform lowers the item by one layer, usually a thickness of 0.05mm to 0.15mm. After completion the part is cleaned of excess resin and cured in a UV oven.

Support structures are required to prevent the item from buckling under gravity and to hold the item in place during the manufacturing process. These are manually removed afterwards.

SLA machines cost between $100 000 and $500 000 to buy and the resin costs $65 to $175 per litre. Chuck Hull patented the process in 1986, founding 3D Systems to commercialise his invention. Hull's ideas are covered by more than 60 US patents. In February 2011, he launched his Dental CAD/CAM 3D printers to produce crown, bridge and partial dental implants.

These are all expensive processes and the devices produced are limited by the size of the machines that produce them. Laminated object manufacturing was developed by Helisys in which layers of adhesive-coated paper, plastic or metal laminates are successively glued together and cut to shape with a laser-cutter. It has lower costs than the other devices but, obviously, produces less complex objects. The parts, however, can be quite large.

In 1997, Arcam, a Swedish company, developed Electron Beam Manufacturing (EBM), which melts metal powder in a process similar to SLS to produce production-ready metal components. Their solid freeform fabrication produces fully dense metal parts under a vacuum, which also permits manufacturing of components from oxygen-reactive materials like titanium.

The real benefits of Arcam's process are in medical device customisation. They produce medical implants, including ace tabular cups used in hip-replacement surgery. To date, 10 000 cups have been implanted. Arcam competes directly with EOS, a German firm's

direct metal laser sintering process. However, DMLS requires post-production heat-treatment. The process speeds are around 80cm^3/h. The company also produces components for the aerospace industry where weight-reduction is critical.

Additive manufacturing changes the way in which a device is designed. In subtractive manufacturing, much of the design is there simply as a result of the requirements of production – where material will be cut away is as much a function of the limitations of the manufacturing process as of design. This means that additive components can use less material making them lighter and using less energy for production.

All of this innovation has reached the consumer market. MakerBot, founded only in January 2009 by BrePettis, Adam Mayer and Zach Smith, produce the Cupcake CNC, a small, box-shaped 3D printer using the FDM/FFF process. A DIY kit will cost you $1299 and, combined with other open-source electronic and microcontroller devices like the Arduino system, you have the makings of a complete fab lab in your own home.

"If you have trouble putting Ikea furniture together, get a friend to help you," explains BrePettis, co-founder and chief executive of MakerBot. "But, for a tinkerer, making something that makes things is the Holy Grail.

"If we were engineers, this thing would cost 100 times as much. But our goal is to democratise manufacturing so anyone can have a machine that makes anything they need. We want to render consumerism useless – and that doesn't work if the machine isn't cheap."

Of course, he's fooling himself. This is all about customised consumerism.

Online companies like Shapeways allow you to upload your own designs and they will manufacture and distribute them on your behalf. Shapeways even allows you to customise designs online and then send them to yourself. Their 'Lightpoem' is a lamp-shade that you can customise with a 3D print of your favourite poem. Zybar is a DIY guitar produced on the open-source 3D modelling software, Blender, and sold on Shapeways for $175. You can use Blender to redesign the guitar to your own needs, print via Shapeways and get it mailed to you. Google has its own software, called Sketchup, which also allows you to produce 3D designs for manufacturing.

ThingLab offers a 3D scanning and printing service that allows you to convert prototypes into production, inverting the original use of these 3D printers.

Manufacturers, from HP to Stratasys now sell direct to industry and it won't be long before you'll be able to buy retail at your favourite computer store.

Now let your mind open up to all the other printing technologies. In a process similar to ink-jet printing, many of the most common solid-state electronic components are also produced through additive manufacturing. Just

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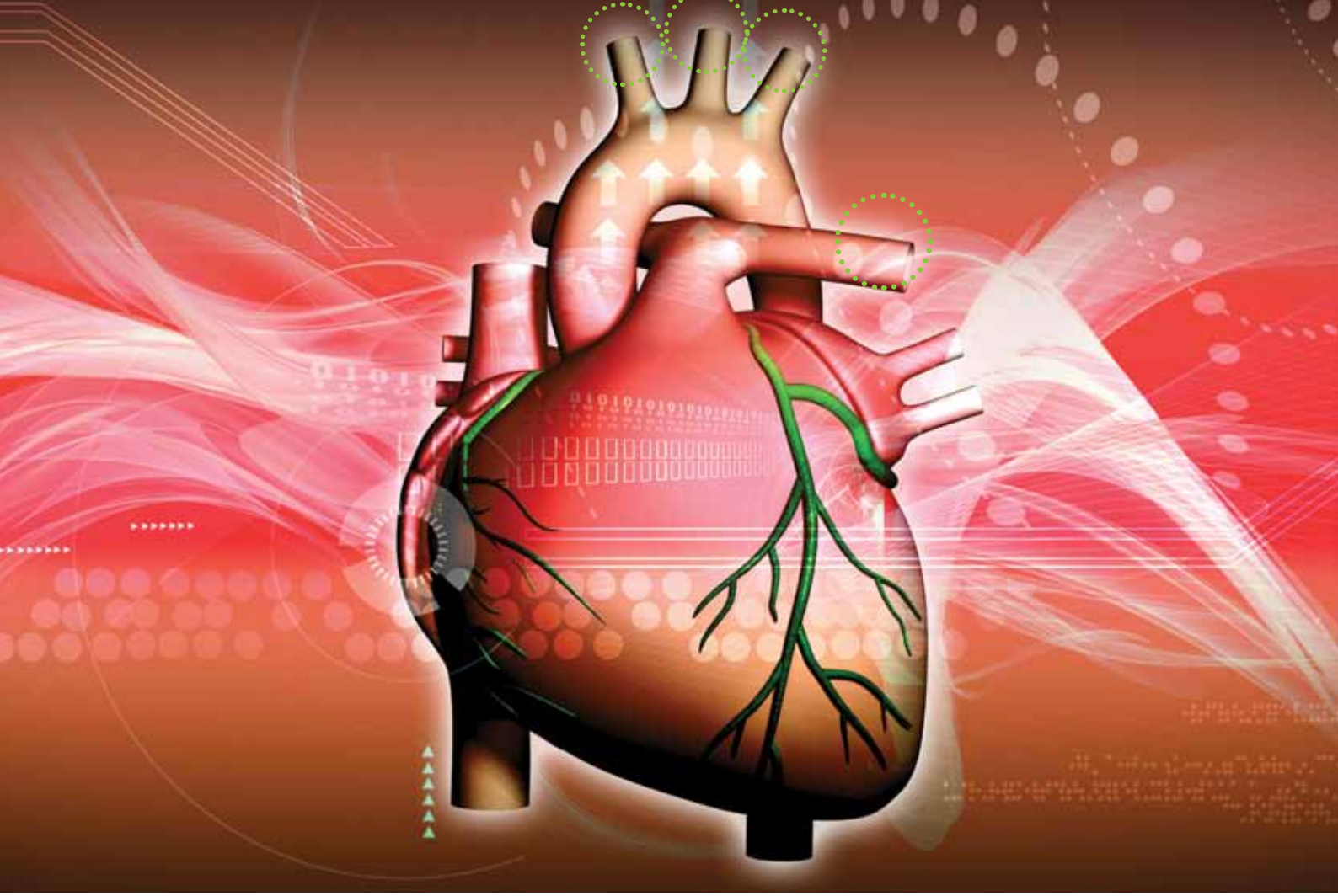

about any type of electronics can be produced in this way. Thin Film Electronics is a Norwegian print electronics company based in Oslo which produces rewriteable, non-volatile memory using ferroelectric polymers in a roll-to-roll printing process. They've been doing this since 1994.

The process of manufacturing is changing. Stratasys intends to produce an entire car in one of its 3D printers. Consider what this means to the world of work.

These machines can be programmed to manufacture themselves as well as the consumer and industrial products their clients want. A full series of fabrication labs would contain specialised 3D printers, electronic component printers and a robotic assembly line. If devices in the assembly line break they're simply replaced from within the production process.

On the positive side, such manufacturing uses less material and less energy than any other form of manufacturing. On the negative, it also requires fewer people. Those it does are likely to be programmers and designers, not blue-collar workers.

More importantly, this technology is open to anyone. The US and European governments believe that such processes will allow manufacturing to return to their nations. This wouldn't create that many new jobs and there is nothing to stop the Chinese from manufacturing in the same way.

Mass production is likely to give way to mass customisation. Everything from clothing to household devices to your motor car could be customised to your own taste. CAD and Computer Aided Manufacturing designs will be bought, sold and customised. They'll also be stolen, adding a whole new dimension to the piracy debate.

Consider the scale of change that this unleashes. Everything, from the way we certify safety and regulatory compliance in manufacturing to the way we work and buy, will change. This won't be fast, but it will happen.

Professor James Yoo, at the Institute of Regenerative Medicine at the University of Wake Forest, is taking 3D printing even further with a system to print skin directly onto burn wounds. Bio-printing, as the new technology is known, is already making waves. "The bio-printer has a built-in laser scanner that scans the wound and determines its depth and area. The scan is converted into three-dimensional digital images that enable the device to calculate how many layers of skin cells need to be printed on the wound to restore it to its original configuration," says Lin Edwards of Physorg.com.

Professor Hod Lipson, director of Cornell University's Computational Synthesis Laboratory, has used a bio-printer to produce a human ear based on a computer scan of an existing ear. The objective is to print with cartilage. At the moment Lipson's device is used to produce synthetic heart valves.

And if this is ambitious at the biological level, consider Contour Crafting. They are working on a large-scale device that will be moved to a building site where it is to produce entire homes, offices and factories.

Of course, societies have survived such technological transitions before. Agriculture, a mere 100 years ago, employed 60% of Americans. It still does in many parts of Africa. However, the Industrial Revolution of the 18th century created winners and losers

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as well as tremendous societal disruption.

The claim that such micro-manufacturing would lead to 'de-urbanisation' is oversold. People like cities and more than 50% of humanity now live in them. Cities have tremendous influence on culture and the requirements for such customisation in the first place. Someone will still have to produce the inputs for these printing devices and the raw materials are themselves not simply dug out of the ground. They have to be processed. Work isn't going to vanish, but it will change.

If the experiences of the Internet are anything to go by, customised manufacturing will unleash a wave of creativity and wealth creation. As usual, this will also throw poverty into stark relief.

Future workers will require a greater level and range of skills. Creativity will be rewarded like never before. However, customisation also reduces the opportunity for individual companies to corner the market in production. Yet, yet ... perhaps a new type of Google will emerge that permits the aggregation of the best designs and finds you the nearest fabricator to produce your new mobile phone.

SA's newest weather station on a **ROCK**

South Africa has opened its new multi-million rand weather station, situated on a bleak piece of rock in the Southern Atlantic Ocean known as Marion Island.

Many thousands of birds and small mammals live on the island that was formed about 500 000 years ago by an undersea volcanic eruption. It covers a total area of 290km^2 and there are no roads crossing it.

Most hikers would be able to trek around the rugged shores in about a week.

Normally just 18 people live here during the harsh winter season where temperatures range from -8 to -15°C and gale-force winds of up to 120km/h occur several times a year. It generally rains for about 317 days out of 365.

South Africa has occupied this part of the world for more than sixty years when it was formally annexed by the country in 1947. Marion Island and its neighbouring Prince Edward Island have been the preserve of weather men and women and scientists who study anything from climate change to the biology of sea lions or the mating habits of albatrosses.

The voyage to Marion Island takes about two weeks to cover the 2000km in the rough Southern Atlantic Ocean. The polar supply ship, SA Agulhas, is used to ferry people to and from the island usually for about six months at a time.

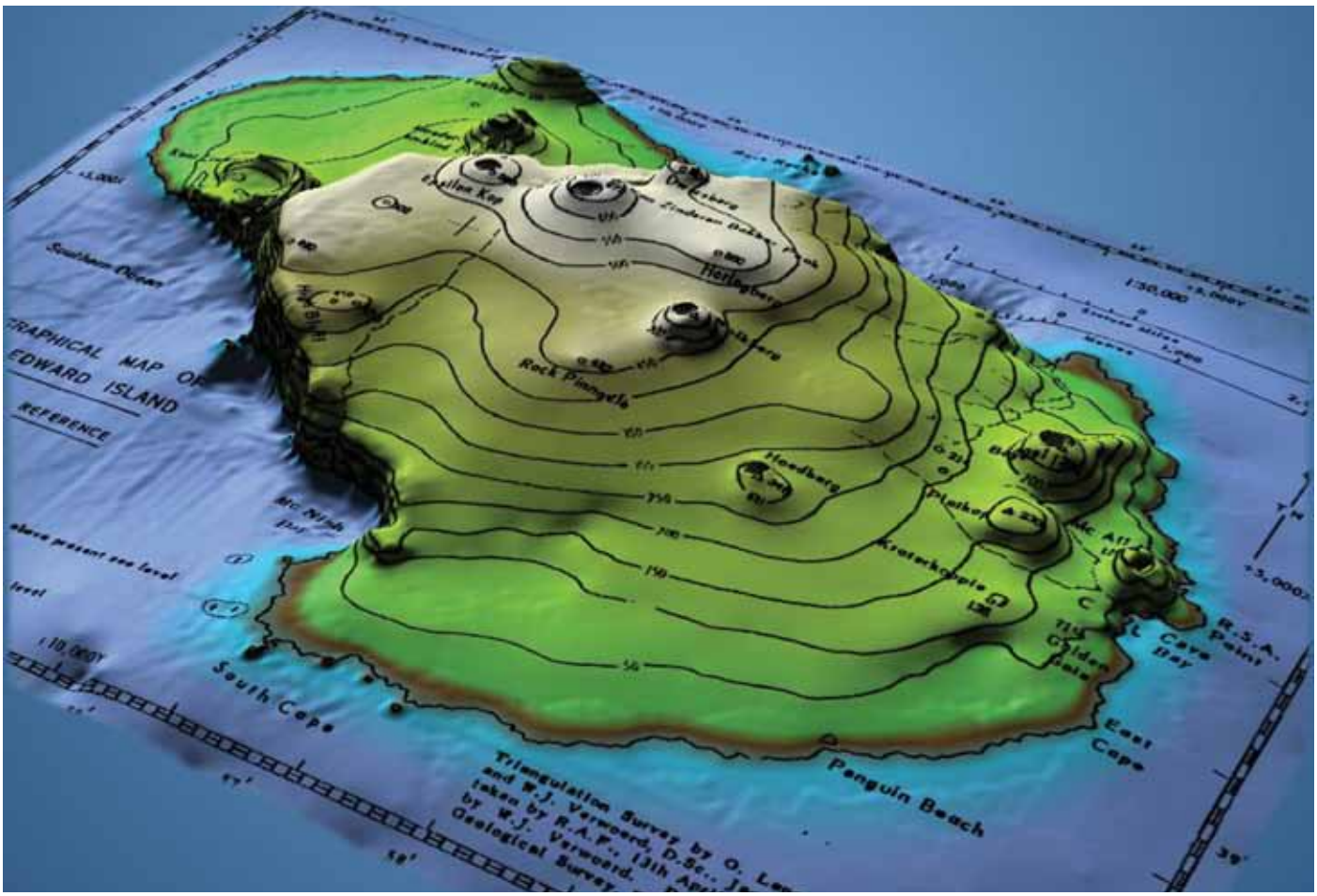
A new weather base station costing R200-million has been successfully built on the island to replace the ramshackle collection of buildings that date back to the 1950s.

The new complex will be able to house up to 980 people and is equipped with modern scientific laboratories, excellent kitchen and dining facilities and additional scientific infrastructure to support the work done by scientists at the base station.

It also has a small gymnasium, sauna and whirlpool bath for the residents. All electricity is produced using diesel generators and telephone and e-mail links are via a satellite link.

More than 6000t of construction equipment was carried to the island using a short-haul helicopter. About 9000 helicopter flights were needed to get the construction materials to the base station.

The new base station can be viewed via a website set up by the weather bureau. It can be reached at http://marion.sanap.org.za.



Japan **MELTDOWN** nuclear fears widespread

Amid fears of a nuclear meltdown after the severe earthquakes in Japan, a group calling itself the Union of Concerned Scientists based in the United States accused the American government of deliberately allowing the federal Nuclear Regulatory Commission (NRC) to operate plants even though these plants have leaky pipes, electrical malfunctions and other minor but potentially dangerous problems.

David Lochbaum, who released the report on behalf of the scientists, says that the NRC is spinning wheels on a slot machine and points out that if "one ingredient causes a puddle on the floor, two ingredients could yield a near miss and all three ingredients could result in a nuclear disaster."

Chairman of the NRC, Gregory Jaczko says that while some of the nuclear plants are old, safety at these plants has not been ignored and stringent procedures to ensure safety have remained in place.

David McIntyre, spokesman for the commission said that the fact that a group of concerned scientists could scrutinise the different regulatory reports indicated that not only was the system working but also it was sufficiently transparent to allow these scientists to understand exactly what is happening in each nuclear plant in the United States.

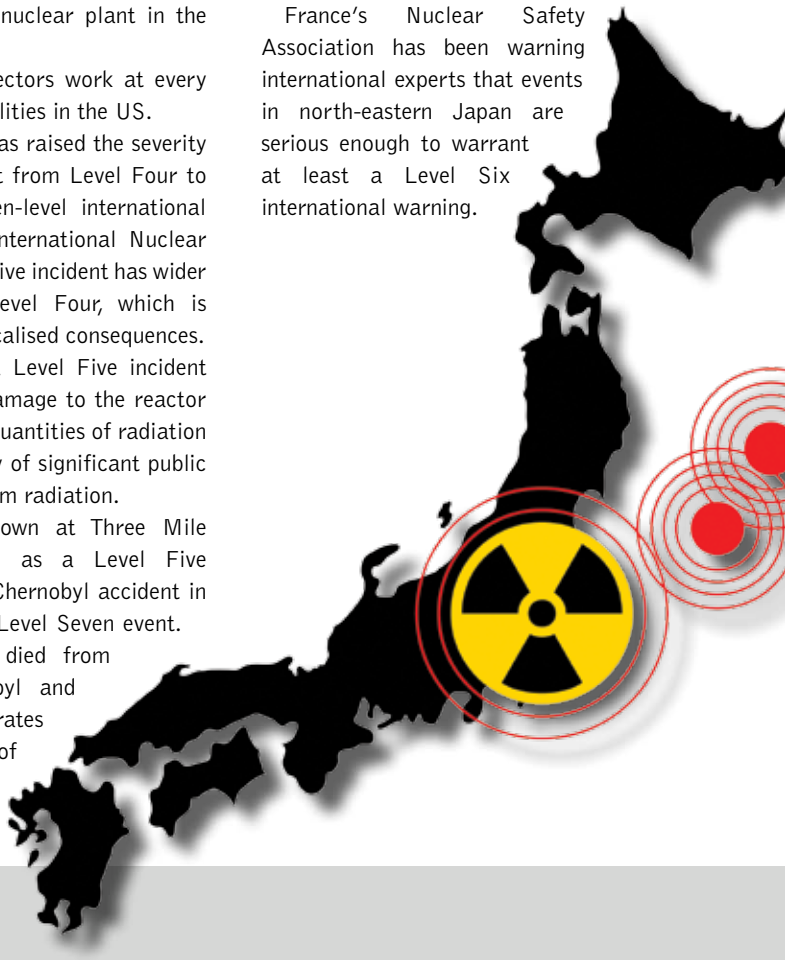
Resident NRC inspectors work at every one of the nuclear facilities in the US.

Meanwhile, Japan has raised the severity of its nuclear accident from Level Four to Level Five on a seven-level international scale known as the International Nuclear Event Scale. A Level Five incident has wider consequences than Level Four, which is restricted to purely localised consequences.

The hallmarks of a Level Five incident are typically severe damage to the reactor core, release of large quantities of radiation with a high probability of significant public exposure or deaths from radiation.

The partial melt-down at Three Mile Island was recorded as a Level Five incident whereas the Chernobyl accident in 1986 was rated as a Level Seven event. At least 31 people died from radiation at Chernobyl and long-term cancer rates across an area of hundreds of square kilometres rose sharply because of the population's exposure to radiation.

France's Nuclear Safety Association has been warning international experts that events in north-eastern Japan are serious enough to warrant at least a Level Six international warning.



Orbit or **ABORT**

A small spacecraft that is about the size of a typical desk is on its way to Mercury and, according to NASA, it will be applying its brakes all the way until it goes into orbit around the tiny planet.

It is the first man-made object to venture so far into space having travelled almost eight billion kilometres over six-and-a-half years. The Messenger spacecraft will move into an egg-shaped orbit around Mercury to try to fight the huge gravitational pull being exerted on it by the Sun.

It will also use about 50% of its fuel to reduce speed sufficiently to enter the orbit. Messenger is due to circle the planet at a distance of 193km for a year. It will go into orbit in the first week of April and will then start surveying the planet.

Messenger's primary mission is to try and unravel the mysteries of the enormous magnetic field that encircles Mercury. Although the closest planet to the Sun, it has large, deep craters that have what appears to be permanently frozen ice inside them.

If things don't go according to plan the $446-million spacecraft will fly past Mercury and end up circling the Sun. NASA says it will know within an hour of the scheduled orbit path on April 4 whether the mission has succeeded or if it's been a total flop.

Ralph McNutt of the John Hopkins University says that it's like playing a game of space billiards from an extreme distance. If things do not go according to plan NASA will have less than three weeks to correct the problems.

The cameras on board the Messenger are being closed down for the period it takes the craft to enter its orbit so no pictures of the approach to Mercury will be available.

Mariner 10 flew past Mercury 36 years ago.

Earthquakes are just a viscous cycle

Geological engineers say that understanding quartz deposits around the world could be a key to predicting earthquakes, mountain formation and other continental tectonics according to a study by geophysicist Anthony Lowry of Utah State University and his colleague, Marta Perez-Gussinye at the University of London.

The findings may help to solve a riddle about the formation and location of earthquake faults, mountains, valleys and plains. The two colleagues examined temperatures and gravity across the western parts of the United States using a network of seismic instruments normally used to describe the geological properties of the Earth's crust. Lowry said that breakthrough came when repeated testing revealed a correlation between quartz deposits and geological events. Using a newly developed technology known as Earthscope, Lowry and Perez-Gussinye found that quartz indicates a weakness in the Earth's crust that is likely to spawn a geologic event such as an earthquake or a volcano.

The massive earthquake that struck Japan in March actually pushed the country eight feet (2,48m) closer to the United States as the Asiatic tectonic plate slid under the North American plate.

The team linked the properties of rocks to movements in the Earth and this, they said, explained how quartz contains trapped water that is released when it is heated under stress. It allows rocks to slide and flow in what Lowry refers to as a viscous cycle.

Lowry says that his findings could help scientists in assessing the likelihood and strength of earthquakes in places such as Arkansas, which are largely geologically inactive.

He says another example is the New Madrid Fault near St Louis that unleashed an earthquake in 1812 that was strong enough to reverse the flow of the Mississippi River but has been dormant ever since.

LHC resumes work after **shut-down**

Particle collisions have resumed at the CERN Large Hadron Collider as part of a range of miniaturised experiments aimed at finding what could possibly have caused the origin of the cosmos.

Oliver Buchmueller, one of the world's leading physicists working at the $10-billion facility says that the top priority for scientists in 2011 and 2012 would be to find evidence of super-symmetry, extra dimensions, dark matter, black hole production and the elusive Higgs-Boson particle.

The concepts and ideas are not new to science but using a LHC to track what happens when particles do collide is regarded as one of the new frontiers of scientific research. It also has given greater impulse to theories on whether the known universe is alone or is just one of very many universes. Both Steven Hawkings of Britain and United States mathematician Brian Greene expect the LHC to shed some light on whether there was another universe before the Big Bang or perhaps even parallel universes that exist alongside our own.

All activity at the LHC was suspended after it had been operating for eight months. Urgent servicing of components used in the LHC was needed and this forced the closure of the CERN facility buried beneath the mountains between Switzerland and France.

Four research teams are based at CERN and they monitor each one of the many explosions that take place at the LHC.

Buchmueller says that scientists are hoping to find proof of super-symmetry or SUSY which allows for the existence of unseen doubles of basic particles and could explain the existence of dark matter. Dark matter is believed to make up about a quarter of the known universe but at this point no-one is quite sure what it is.

If the existence of SUSY is established then it will create a backup for string theory, which allows for up to six additional dimensions other than the known four of length, breadth, depth and time.

Greene argues that string theory allows for the existence of multiple and perhaps ever-multiplying universes.

Ed: Engineers, why not tell us your views on string theory, the LHC, the Higgs-Boson particle and dark matter? After all, if these things are true then engineers will have to work out their practical application eventually.

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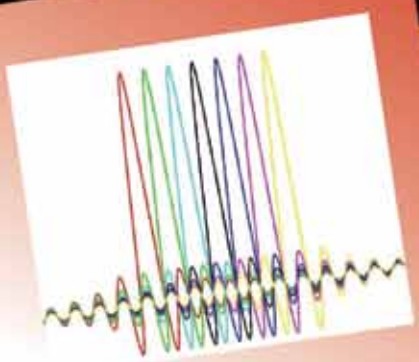

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E-mail: hcferreira@uj.ac.za
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tgswart@postgrad.uj.ac.za
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WHOOSH

There is an electric **Phantom** on the prowl

By Paddy Hartdegen

Vehicle manufacturers from Japan and Europe – some representing the largest brands in the world – have embarked on major investments in research, development and commercialisation of electric vehicles for the future.

For instance, BMW has just announced that it will form a €100-billion joint venture with Peugeot and Citroen for hybrid technologies that will see marques in all three groups being developed.

The BMW Group and PSA Peugeot Citroen have started the BMW Peugeot Citroen Electrification programme aimed at developing various hybrid solutions. The new company will be based in Munich, Germany, and in Mulhouse, France, and it expects to have more than 400 people working for it before the end of this year.

Philippe Varin, chairman of PSA Peugeot Citroen, says the joint venture will create an open European platform to foster the development of European standards for hybrid technologies while enhancing the advanced technological manufacturing expertise needed for new hybrid technologies.

His views are echoed by BMW Group chairman, Norbert Reithofer, who says that the two groups share the same vision regarding the importance of hybridisation for the future. "The JV will enable us to join forces and this has significant benefits in terms of economies of scale, shared development costs, using standardised components and creating a faster development cycle," claims Reithofer.

All research and development work is being done at the Munich plant while the Mulhouse plant will focus on manufacturing components and systems. The management of the new company and most of the employees are expected to be drawn from staff currently working at BMW, Citroen or Peugeot.

Of course, the new venture by BMW and Peugeot Citroen is just one of several new developments aimed at switching away from a complete reliance on fossil fuels for vehicle engines. As if to underline this point, Rolls Royce is developing its Phantom Experimental Electric vehicle.

Rolls Royce – perhaps one of the most iconic and legendary vehicle brands in the world – is no longer a British company, having been taken over by BMW several years ago. But it still represents the finest in motoring today and its vehicles are regarded by many as the best cars in the world.

Rolls Royce Motor Cars has now developed its test vehicle, the 102 EX that explores alternatives to traditional internal combustion and HaloIPT. A British company will supply the revolutionary induction charging technology that is being used in the Phantom electric model.

The fully electric vehicle is one solution to an alternative power train and the Phantom 102 EX has been built as an alternative to the V12, 6,75-litre internal combustion engine currently used in the Phantom.

The performance of electric and petrol engines can be compared directly to a Rolls Royce Phantom by anyone interested in owning or buying one, and that is important for the customers, claims Rolls Royce's chief engineer, Andrew Martin.

"The Phantom 102 EX has a 96-cell lithium ion battery pack, 3-phase battery chargers and two water-cooled motors. The battery packs are located under the bonnet but the motors and gearbox are at the back of the car – where the fuel tank is in petrol versions – so that it maintains its rear wheel drive characteristics.

"The electric power cables run under the floor in the channel that normally houses the propeller shaft. The performance of the electric vehicle is truly silent, creating the whoosh that is so much a hallmark of the Rolls Royce brand," says Martin.

The Phantom 102 EX will use HaloIPT's inductive power transfer technology and HaloIPT is the first company in the world to provide a wireless charging technology that allows cars fitted with an integrated receiver to charge automatically when parked. It uses transmitter pads that are buried in the ground at predetermined points.

The system is extremely tolerant, so that even if a vehicle is not parked properly over the pads, it is still able to efficiently transfer power at a rate that matches ordinary plug-and-cable charging methods.

The technology is designed to be used when buried under a layer of asphalt and even works under water or when covered in snow or ice. Apparently the IPT system can be used to work with all road vehicles from small city runabouts to trucks.

According to Dr Anthony Thomson, chief executive of HaloIPT,

VHOOSH

infrastructure providers will embed IPT technology into roads so that cars can be charged even when they are moving.

"Dynamic in-motion charging represents the most effective way of solving the range issues faced by electric vehicles today," claims Thomson. "We are delighted that our system has been chosen by the manufacturers of the world's most luxurious vehicle brand and we believe this technology will unlock the potential of the electric car market for the future.

In order to ignite global interest in its project, Rolls Royce has developed its own website (www.electricluxury.com) for anyone interested in its plans.

Meanwhile another luxury car manufacturer, Mercedes Benz, has announced plans to export its widely-used Vito range of vans to Spain where the first Vito E-Cell electric models will be sold. The range has been available in Germany for some time but it is only now being exported to other European countries.

The first five vehicles have been put to the test in Vitoria where the supermarket chain Eroski is using them to ferry goods from distribution centres to the franchised supermarkets.

The electromotive Vito E-Cell is no longer an experimental vehicle and the batteries provide the van with 36kWh, sufficient to cover a distance of 130km before recharging. The electric motor has an output of 60kW and torque of 280N/m and a top speed of 80km/h. The supermarket chain has apparently ordered more than 2000 of these vehicles for its Spanish operation.

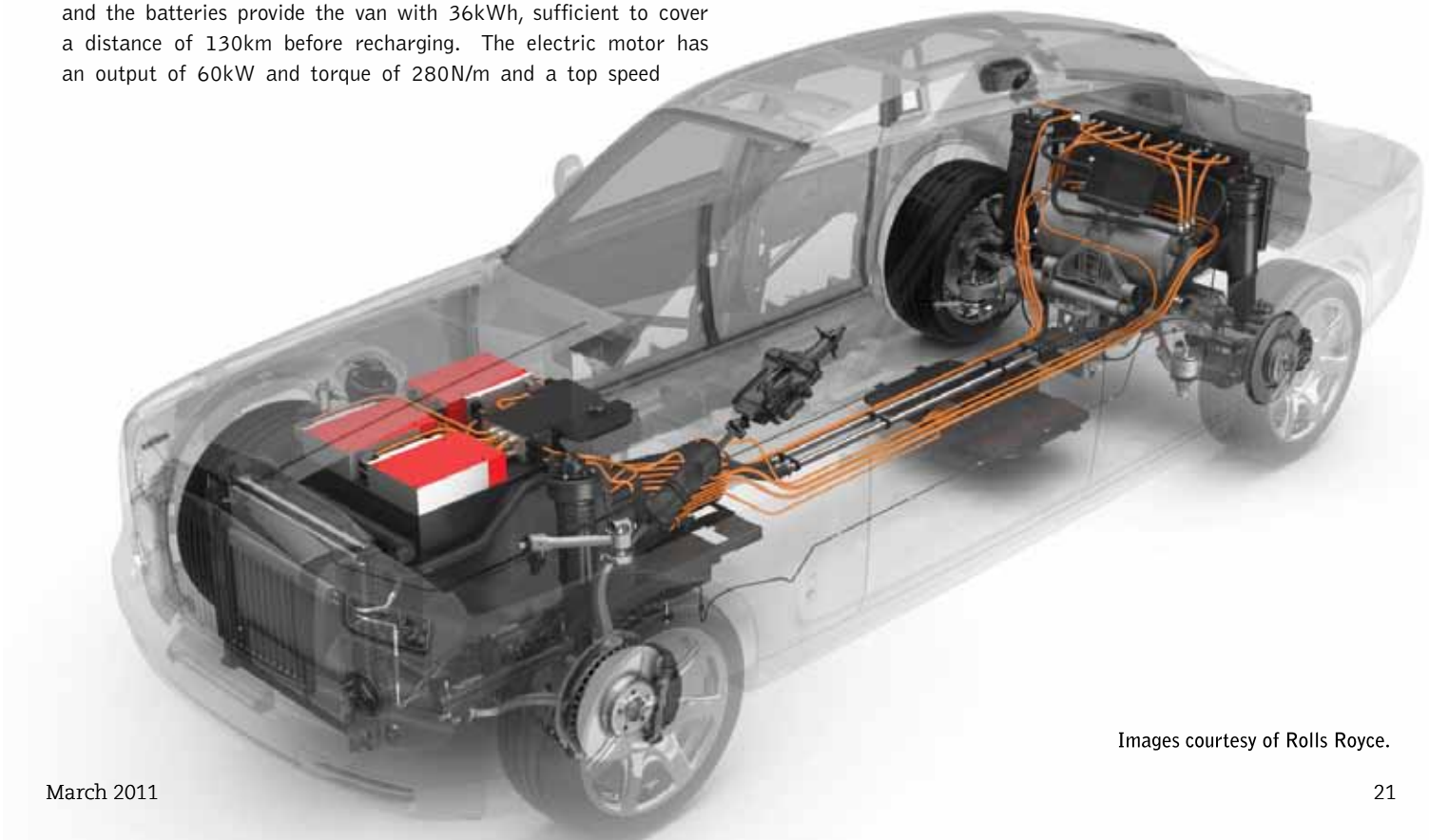
Not to be outdone by competitors, Nissan has also announced that it is developing its first Esflow electric sports car that is said to provide the full thrill of high speed motoring without the use of fossil fuels.

The Esflow is a rear-wheel-drive two seater with one electric motor for each of the rear wheels. It uses laminated lithium-ion batteries mounted low down in the chassis for better weight distribution. Acceleration from 0 to 100km/h is achieved in under five seconds and the car has enough power to cover up to 240km in a single charge.

The Esflow comes after the successful development by Nissan of its Leaf model and is based on existing technologies. The Esflow has a carbon fibre composite body, mounted on an aluminium chassis and comes with low profile tyres fitted to six-spoke magnesium alloy wheels.

It has been designed as an electric sports vehicle rather than being adapted from some other design to run on electric power like so many vehicles on the market today, claims Nissan.

The Esflow was launched at the Geneva Motor Show.



Images courtesy of Rolls Royce.

CPD Overview

WATTnow, in conjunction with the SAIEE, launched this programme for engineers who need to meet their professional development commitment by acquiring Continuing Professional Development (CPD) credits in Category One (1). In terms of the renewal of registration requirements, all registered professional electrical engineers, technologists and technicians must earn CPD credits so that after five years they have acquired at least a total 25 CPD credits in all categories and at least five credits in Category One (1). The **WATTnow** CPD Programme provides a convenient and cost-effective way for engineers to acquire the Category One (1) CPD Credits. Failure to certify CPD credits could jeopardise renewal of their registration (CPD credits in the other Categories Two (2) and Three (3) must be acquired by other means – see the ECSA Rules on this aspect).

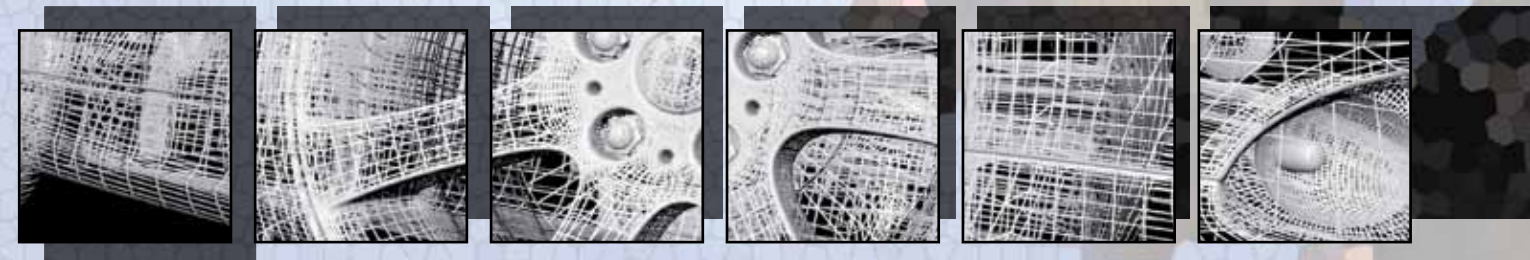
WATTnow publishes CPD articles in each issue that entitle subscribers to the scheme to claim for Category One (1) CPD credits. The programme requires engineers to respond to set questions posed on articles that are specially designed and validated to provide CPD credits. Engineers using the programme can accumulate 0.1 CPD credits per month if all the questions are answered correctly. **WATTnow** is published monthly so slightly more than 1.0 CPD credits can be acquired annually by this method. The articles and questions set are independently validated and reviewed by the SAIEE to which Validation numbers are allocated and should be recorded by subscribers.

Each year, **WATTnow** will supply a series of DVDs of lectures/conferences on topics that have been validated for CPD by the SAIEE. These DVDs can be ordered via the **WATTnow** website by subscribers to the CPD Programme.

Questions relating to the DVDs will be available on the **WATTnow** website and members of the programme can submit their answers online. Correctly answering the questions on the presentations in the DVD will entitle the subscriber to claim credits in Category One (1). These credits are in addition to the credits acquired by answering the questions to the CPD articles.

The SAIEE will provide subscribers with an annual certificate that records the exact number of credits gained for his or her records.

The **WATTnow** CPD Programme is based on a subscription service that will cost non-members of the SAIEE R2 400 a year while members of the Institute will pay an annual subscription fee of R1 000. The programme offers all members of the **WATTnow** CPD Programme a one-stop-shop to participate in and comply with the professional development criteria laid down by ECSA and ensure that all professional engineers can maintain their status without having to search around and pay significantly more to attend CPD courses or conferences in order to acquire sufficient credits for Category One (1) to meet the ECSA requirements.



Satisfied with SPEEDS if you're lucky

South Africa might seem to have masses of bandwidth available to users who are prepared to pay for the right to use this technology, and the picture in other countries is hardly any better. In fact, a new report released in Britain says that consumer satisfaction with broadband services is at an all-time low.

And it's the broadband speeds that are causing the greatest amount of frustration. More than 30% of the 10 000 people surveyed in Britain complained about the service they received from Internet Service Providers (ISPs).

Consumer broadband speeds are typically less than half the average advertised broadband speeds in Britain and, in my personal experience the picture is identical in South Africa – although in South Africa the excuses seem to be somewhat more imaginative.

According to Michael Phillips, product director of Broadbandchoices.co.uk the broadband service providers market their offerings on the basis of speed but the speeds do not live up to the claims.

He has called for service providers to advertise – and be adjudicated on – the typical speeds achieved at a particular time of the day. He says that typical speeds are a more accurate reflection of what users can expect when they sign a service agreement with an ISP.

The predicament in South Africa is virtually identical but the local scenario is complicated by the 'capped' and 'uncapped' offerings. In Britain, all ISPs offer uncapped connections but this is not the case in South Africa.

As new bandwidth was released onto the local market more and more ISPs started to offer uncapped bandwidth and the net effect was that certain ISPs were unable to supply the necessary bandwidth for uncapped access, resulting in a significant performance loss.

This has in part been overcome but there is certainly no guarantee that your 4096 line will be running at that speed constantly, no matter what Telkom or any other ISP says.

Moreover few service providers – or consumers for that matter – actually highlight the impact that blended and unblended bandwidth can have on performance. So ISPs always can revert to the 'blended' aspect of their service to explain performance levels.

Suffice to say that if a survey of South African Internet users were conducted, only about 30% of the users would be likely to say they were happy with the bandwidth speeds provided. The balance would certainly not be.

Coincidentally, it's exactly the same number as the Ofcom report recorded for British Internet users who were just as dissatisfied as South Africans.

A touching tale

By Gavin Chait

So, where were you thinking of eating this evening?" asked the young woman. She slid a glass cylinder topped with a purple tag labelled 'Dining' onto the glass surface of the table between herself and the young couple.

Image courtesy of Microsoft.

A map on the surface responded to the cylinder, highlighting restaurants in the area the couple had already chosen for their evening out.

"I'm not sure," said the young man. "What's five minutes' walk away from here?"

The guide nodded and twisted the glass cylinder on the surface as a grey zone grew and encompassed some of the tagged restaurants. "These," she said. "Let me show you the reviews."

So saying, she touched a few of the restaurants, using both her hands to open up the reviews. The young man's companion reached across and slid some of the reviews to her, twisting them round so she could see. The young man, similarly, read a few. All three people interacted simultaneously on the surface of the table.

No, it's not some science fiction movie. It's the tourism office in the Manchester city centre.

Opened in June 2010, and costing around R9 million to build, it features several of Microsoft's Surface computing platforms. The 360-degree user interface is a 76cm reflective surface capable of object recognition, finger recognition and tracking, and is both multi-touch and multi-user. It can respond to up to 52 individual touches at a time.

During a demonstration with a reporter, Mark Bolger, the Surface Computing group's marketing director, 'dipped' his finger in an on-screen paint palette, then dragged it across the screen to draw a smiley face. Then he used all 10 fingers at once to give the face a full head of hair.

Microsoft engineers Steven Bathiche of Microsoft Hardware and Andy Wilson of Microsoft Research first proposed it in 2001, and Steven Spielberg borrowed the idea to feature in his 2002 hit, Minority Report. Microsoft CEO Steve Ballmer launched the first commercial version of the Surface on 30 May 2007 at The Wall Street Journal's 'D: All things Digital' conference in California.

The technology behind it is created by a near-infrared, 850nm-wavelength LED light source aimed at the surface. When anything touches the surface the light is reflected to multiple infrared cameras. Sophisticated software then processes that data to allow interaction.

What is interesting is how the system can permit a user to lean on the table while still interacting with it.

Touch screen technology has come a long way since the HP-150 produced by Hewlett-Packard in 1983. The desktop computer was not IBM compatible but it did run a customised version of MS-DOS versions 2 and 3 and had a whopping 256KB of RAM.

It wasn't strictly a touch screen. The 9" Sony cathode ray tube was surrounded by infrared emitters and detectors. These beams would be broken by the interference of any non-transparent object on the screen.

Back in 1983, graphics processors—never mind interfaces—were still rather rudimentary. That, and the fact that the infrared emitters were placed in small holes, which would fill with dust, along the monitor's bezel made touch technology rather esoteric. They cost the equivalent of R42 000 in 2011 money and this would have been rather hard to justify.

The first touch sensor, developed by Sam Hurst in 1971, wasn't even transparent. He called his device the Elograph. His company, Elographics, patented the first transparent touch sensor in 1974 and then, in 1977, the five-wire resistive sensor. This, the most popular, is still in use today.

The Fairlight CMI was a musical sampling and synthesis workstation, which used a light pen to allow the user to allocate and manipulate sample and synthesis data. These enjoyed a lengthy period on the market from 1979 to 1985.

And where would you expect to find the first production environment using touch screens? Why CERN, of course.

"The proton synchrotron currently being built by CERN (the SPS) will be controlled centrally from three control desks, each with its own minicomputer. Only a few knobs and switches must control all of the many thousands of digital and analogue parameters of the

accelerator, and an operator will watch the machine on, at most, half-a-dozen displays ... . An advantage of the new form of control is that since there are so few controls and displays, they may be made more elaborate and powerful." Thus begins a CERN report written in May 1973 by Frank Beck and Bent Stumpe of the controls group.

Stumpe would go on to develop a very early capacitive touch screen. As described by CERN, "In a handwritten note dated 11 March 1972, Stumpe presented his proposed solution – a capacitative touch screen with a fixed number of programmable buttons presented on a display. It was extremely simple mechanically. The screen was to consist of a set of capacitors etched into a film of copper on a sheet of glass, each capacitor being constructed so that a nearby flat conductor, such as the surface of a finger, would increase the capacity by a significant amount. The capacitors were to consist of fine lines etched in copper on a sheet of glass – fine enough (80μm) and sufficiently far apart (80μm) to be invisible (CERN Courier April 1974 p117). In the final device, a simple lacquer coating prevented the fingers from actually touching the capacitors."

However, none of these were really consumer devices.

There are an incredibly diverse range of touch screen technologies. The most common, even today, are the resistive in which two thin, electrically conductive transparent layers are separated by a narrow gap (either air or by micro-dots). Any object pressed against this surface causes deflection and the two surfaces touch. The panel then behaves as a pair of voltage dividers with connected outputs. The difficulty for processing is that multiple touches simply result in a confused signal. On the other hand, resistive screens can offer greater precision than other approaches and can recognise input from anything placed against the surface.

Surface acoustic waves (SAW) were first explained by Lord Rayleigh in 1885, in which energy waves have a longitudinal and a vertical shear component that can couple with any media in contact

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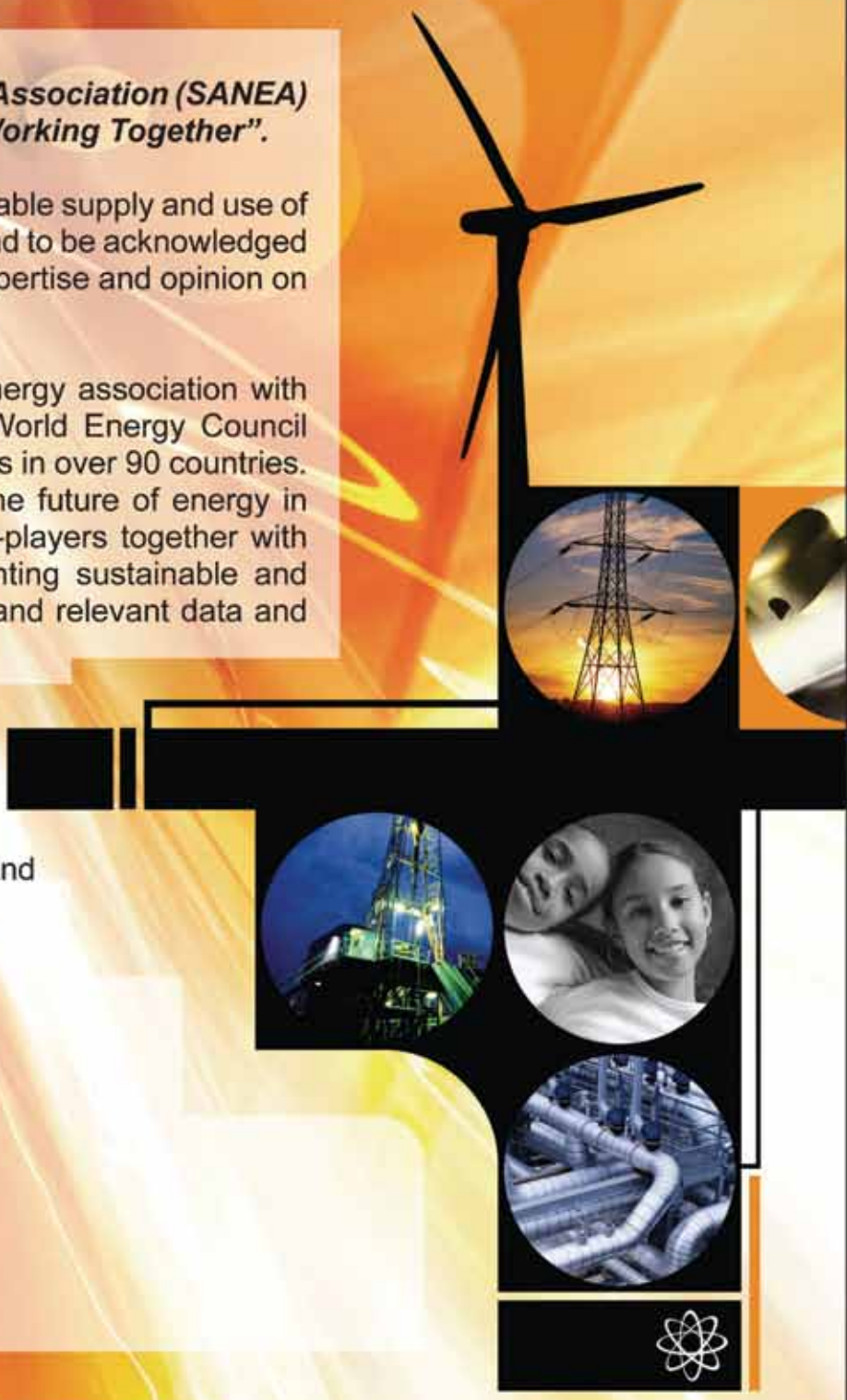

Chairman: Brian A Statham
Mobile: +27 (0)82 652 7580
Email: brian.statham@eskom.co.za

Marketing Manager: Sarita Cronjé
Mobile: +27 (0)83 325 6716
Email: saritac@mweb.co.za

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with a surface. This coupling strongly affects the amplitude and velocity of the wave which can permit a sensor to detect mass and mechanical property of the media causing the waves.

Rayleigh's SAW theories were an extension of his explanation for the elastic scattering of light or other electromagnetic radiation by particles smaller than the wavelength of light. Rayleigh scattering is a function of the electric polarisability of the particles and explains, amongst other things, why the sky is blue. A rather clever man, Lord Rayleigh.

The transduction of electric energy to mechanical energy is derived by piezoelectric materials. These SAW filters are used in mobile phones but haven't been of any major commercial success.

The most popular of current touch-screen devices is that used in Apple's iPhone; capacitive touch screens. Such devices require that the object doing the touching be capacitive. So, while more sensitive, they cannot be used with pen-input.

Indium tin oxide is sufficiently transparent and is used to produce the capacitive sensor on glass surfaces. There are a number of different approaches, depending on the application, for producing these capacitive sensors. Surface capacitance relies on a single coated conductive layer transmitting a small voltage, resulting in a uniform electrostatic field. It isn't particularly accurate and so tends to be used in industrial controls and kiosks.

Projected Capacitive Touch (PCT) permits more accurate and flexible operation, by etching the conductive layer. An X-Y grid is formed either by etching a single layer to form a grid pattern of electrodes, or by etching two separate, perpendicular layers of conductive material with parallel lines or tracks to form the grid.

Multi-touch requires more sensors and more capacitors. Such mutual capacitive sensors require a capacitor at every row-column intersection. A 12-by-16 array would require 192 independent capacitors. This massive processing requirement is one reason why multi-touch devices are still relatively imprecise. Apple's phones are, obviously, multi-touch.

Wacom has developed a range of touch-sensor devices that are used by commercial artists. Their Cintiq is a table/screen hybrid which incorporates an LCD screen into the table allowing a user to draw directly onto the display surface. Their device offers pressure sensitivity so that drawing is realistic and allows 1600x1200 resolution.

They use electromagnetic resonance technology with the tablet providing power to the pen via resonant coupling. In send mode, the tablet generates a close-coupled electromagnetic field at a frequency of 531kHz.The pen itself communicates pen-tip pressure, the tip type selected and a number of other variables. Their Bamboo device is aimed at home-users and offers both multi-touch and pen-driven control. And I've wanted one for a while now.

In fact, the perfect tablet device for me would be one that combines the electronic ink Amazon Kindle with Wacom's Bamboo writing technology to produce a device that can really be a pen and ink notebook replacement.

IBM's infrared touch screens are still alive and well, though. There are many applications where one can't rely on a conductor to activate the touch screen such as in outdoor environments or point of sale systems. Since the infrared is essentially external to the glass surface, the device itself can be more robust as well.

Tyco International has developed an acoustic pulse recognition system that uses piezoelectric transducers which convert touch-based vibrations into electronic signals. This device also uses ordinary glass but is more accurate than the infrared system and is suited to larger displays.

Most of the main patents were filed in the 1970s and 1980s and are now, fortunately, in the public domain. Newer multi-touch technologies are still being filed, and this has meant that the devices are becoming cheaper to produce. The touchscreen market for mobile devices is worth well over $5 billion annually.

Microsoft is due to launch its Surface 2.0 later in 2011.This is an entirely new re-imagining of its original and is a partnership with Samsung. The new 40-inch screen will be using embedded infrared sensors as part of the LCD display allowing the device to 'see' without using a camera. This permits a much thinner device only 10cm thick.

We're a long way from abandoning our keyboards but we are certainly in an age where our interactions with electronic devices is starting to look a lot more like it does in the movies.

Image courtesy of Microsoft.

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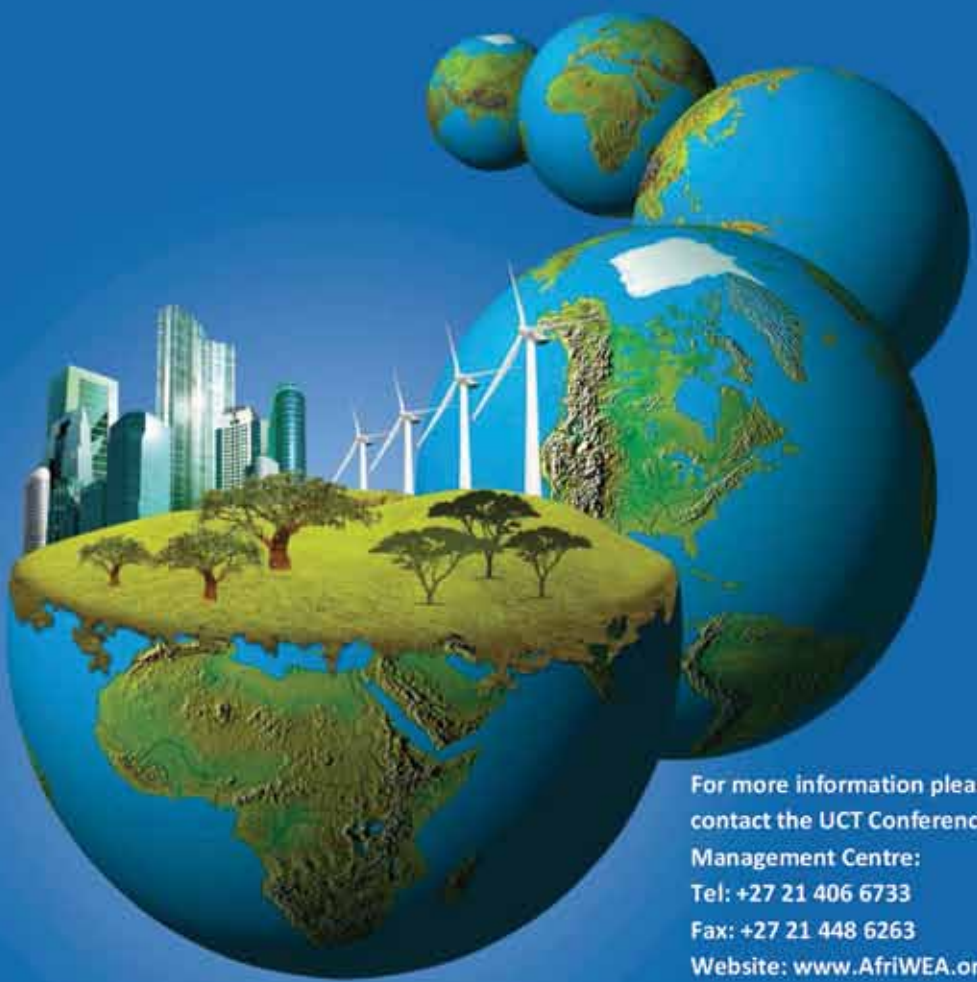

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WIND POWER AFRICA 2011 will take place from 9 – 11 May 2011 at the Cape Town International Convention Centre in Cape Town, South Africa featuring a high-profile Conference & renewable Energy Exhibition, Site Visits, a networking Cocktail, Gala Dinner and Spouses Programme over the 3-day period.

Fit your hearing aid onto your molars

A new type of hearing aid that transmits sound through a person's teeth has been approved for use in Europe. The device, known as SoundBite, directs sounds through the jawbone and into the inner ear.

It is placed onto one of the molars on the right or left hand side. The Royal National Institute for Deaf People warned that the technology may not be suitable for everyone.

Conventional hearing aids use air conduction to increase the volume of sound travelling through the air while SoundBite uses bone conduction to amplify the volume.

The sound is transmitted wirelessly to the prosthetic that is fitted in the mouth. It works by sending vibrations through the teeth and bones directly to the cochlea, bypassing the middle and outer ear.

SoundBite is made by Sonitus Medical and is the first non-surgical device to use bone conduction to improve hearing. The system allows users to hear in stereo.

There are about nine million deaf or partially deaf people in Britain and according to statistics from the Royal National Institute about six million of them require a hearing aid though only two million people actually use one.

SoundBit is just one of the new solutions for deaf and partially deaf people. In February this year a new middle-ear implant device was successfully implanted under the skin.

The Otologics Carina middle-ear device is connected to an electromagnetic vibrator inside the mastoid bone behind the affected ear and attaches to the hearing bones.

The device is completely invisible as it is buried beneath a thin layer of skin and has no external components.

Long live Discovery

in its permanent retirement

The Shuttle Discovery has landed after its last mission into space was completed successfully. It has had an excellent flying career and is NASA's most successful spaceship.

As it was coming in to make its final landing, Commander Steven Lindsey circled the Kennedy Space Centre to reduce Discovery's speed before it landed on the marsh-encircled runway.

Its final mission was to carry a load of cargo to the International Space Station. All in all the shuttle accumulated 365 days in orbit spread over 39 missions and racked up almost 150-million miles (241-million kilometres).

Having landed Discovery safely on the tarmac and brought it to a halt, Lindsey radioed Mission Control in Houston with his final words: "Houston, Discovery. For the final time, wheels stop," he said as the space shuttle stopped.

"Great job by you and your crew," replied astronaut Charlie Hobaugh from Mission Control.

Discovery's sister ships Endeavour and Atlantis will have their final missions in April and June respectively and will deliver a $2-billion Alpha Magnetic Spectrometer particle detector and a year's worth of supplies to the International Space Station.

The space shuttles have been running missions to space for more than 30 years but because of their high operating costs it was decided to stop using them so budget can be freed-up to develop a new range of crafts that can carry goods and people into space.

The new spaceships will be capable of travelling to the International Space Station and will also be able to reach the moon and even travel to distant asteroids.

The last people to fly on the Discovery included Lindsey and pilot Eric Boe along with astronauts Stephen Bowen and Alvin Drew, who made two space walks, and two other astronauts Nicole Stott and Michael Barratt.

Japanese **'QUAKE'** shuts major factories

Manufacturing companies as diverse as Chevrolet and Apple are increasingly concerned by the impact that the Japanese earthquake will have on supply of critical components after major factories shut down in Japan.

While some computer component factories are still running, power outages, shortages of fuel and raw materials and ruptured logistical services mean that products and parts are not being shipped to customers on time.

Honda Motor Company halted production at its factory where more than 20% of all Honda vehicles are made while in France, Opel and Renault have both slowed down their production lines because they do not have enough of the electronic components that are made in Japan.

Toyota and Nissan – two of the largest vehicle exporters in Japan – are both struggling to restart their plants after the earthquake, now rated at 9,0 on the Richter scale, struck in March.

Opel, the European arm of General Motors called for a 32-hour production stoppage at its plant in Saragossa, Spain because it did not have enough electronic components to keep the production lines running. About 2 400 vehicles will not be made in that period.

Renault – which manufactures its cars at its factory in Busan, South Korea – says that it has cut production by 20% as a direct result of disruptions in supply of electronic components from Japan.

The model most affected by the shortage of components is the Samsung SM7. Under normal conditions about 20 000 of these vehicles are made each month. Renault is looking for alternative sources for the components it needs. About $92,3-billion in electronic parts are exported from Japan each year and the country produces about 57% of the wafers used to make chips that go into mobile phones, computers, cameras and other electronic devices.

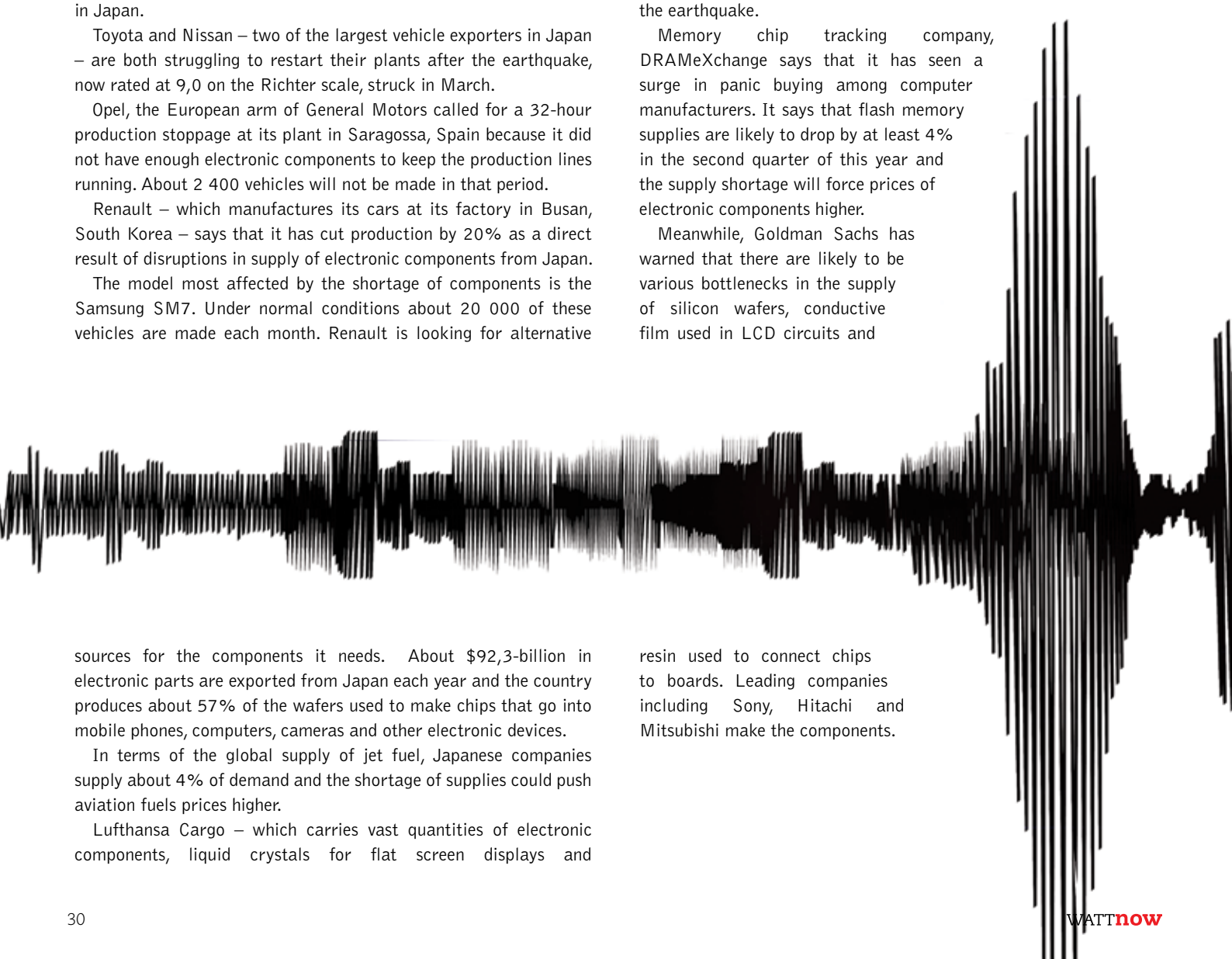
In terms of the global supply of jet fuel, Japanese companies supply about 4% of demand and the shortage of supplies could push aviation fuels prices higher.

Lufthansa Cargo – which carries vast quantities of electronic components, liquid crystals for flat screen displays and pharmaceutical products – warned customers in Europe that flights from Japan had to be cancelled because of the production bottlenecks. Pharmaceutical manufacturer, Novo Nordisk has shut its Koriyama plant for two weeks because 90% of its staff is unable to work. The plant is the world's biggest producer of insulin. Similarly, GlaxoSmithKline's Imaichi plant was out of action as well. It makes a variety of drugs at the manufacturing facility.

Meanwhile, Apple confirmed that its new iPad 2.0 relies on a number of parts from Japanese manufacturers, including the battery and the flash memory used to store music and images on this device. The flash memory used in the iPad is made by Toshiba, whose factory had to be shut down in the wake of the earthquake.

Memory chip tracking company, DRAMeXchange says that it has seen a surge in panic buying among computer manufacturers. It says that flash memory supplies are likely to drop by at least 4% in the second quarter of this year and the supply shortage will force prices of electronic components higher.

Meanwhile, Goldman Sachs has warned that there are likely to be various bottlenecks in the supply of silicon wafers, conductive film used in LCD circuits and resin used to connect chips to boards. Leading companies including Sony, Hitachi and Mitsubishi make the components.



Code protection

doesn't extend to theft

For years computer programmers have been writing code and then protecting that code through various mechanisms including patenting a particular set of instructions or a specific algorithm.

Much like engineers need to protect their designs so computer programmers seek to protect their code. But this protection does not extend to breaking the law as a former Goldman Sachs Group programmer discovered recently.

He was sentenced to eight years in prison for stealing the Wall Street bank's code for its high-frequency trading system. Sergey Aleynikov was charged in July 2009 with stealing the code prior to starting work with Teza Technologies – a high-frequency trader from Chicago.

According to prosecutor in the trial, Joseph Facciponti, the stolen code was Aleynikov's 'golden ticket' into a new job at Teza and he stood to make millions more than he would ever have done as an employee at Goldman Sachs.

Aleynikov planned his actions to remove the code really carefully and it took several months before he had successfully transferred about 500 000 lines of code to an outside server so that he could use the same code in his new job.

While he had developed and written much of the code that was used by Goldman Sachs, his attorney Kevin Marino conceded that Aleynikov had made a 'tragic and foolish' mistake when he removed a copy of the code prior to starting work at Teza.

Aleynikov said that he very much regretted downloading a copy of the code, which he admitted was the property of Goldman Sachs as he had been paid to develop the code for the bank.

It's not the first time that programmers have tried to steal code that is used in high-frequency trading. Last year a programmer from India was found guilty of stealing the trading code from a bank in France.

Hackers hack into security tokens

Secure identification tokens – used by millions of people to access bank accounts or corporate networks – have been hacked and a group of unknown people have managed to steal thousands of passwords and personal identification numbers.

RSA Security confirmed that it had been the victim of a sophisticated cyber attack and posted a letter online apologising to its customers for the inconvenience.

The company says it is providing immediate remediation advice to customers so that they can limit the extent of the theft. The company makes the SecurID tokens widely used around the world.

Two-factor authentication is used by the token: the first is usually a traditional login and password combination and the second factor is that the token is paired to software that generates a new six-digit number every minute.

A token paired with the software generates the same numbers so only the holder is able to type in the right digits and get access to a network or a specific bank account.

RSA said the information stolen could reduce the effectiveness of the two-factor automation system, particularly if a company came under a broader attack by malicious hackers.

Surprisingly, RSA advised customers to use social networking sites to spot if hackers were trying to capitalise on what they know about the SecurID tokens.

Security firm IT-Harvest's Richard Stiennon says that there could be tremendous repercussions if criminals were able to access critical systems such as those used by banks.

LASER and LASER based manufacturing

On February 23, 2011, the Materials Processing group of the CSIR's National Laser Centre (NLC) held an open day to illustrate what laser technology can do for South African manufacturers and to showcase the group's achievements in the 10 short years since its inception. Far from being research-bound, Materials Processing is one of the most industrially active groups in the CSIR, not only in terms of application development, but also offering a component processing service to make best use of its laser investments. Peter Middleton reports.

When I was a child, lasers were all about futuristic weapons of virtual destruction. At university, they were straight-line measuring tools and, in my current travels, laser-cutting seems to have mushroomed into the preferred solution for precision cutting of flat plate – a high-tech flame cutter. Perhaps we get used to the technology bar being continually raised, but I can't help feeling a little disappointed that the technology has not developed towards those exciting expectations implanted in my childhood.

But lasers remain an exciting technology and the NLC Materials Processing group's open day, although as far away from a child's fantasies as you can imagine, did not disappoint.

On arrival I was immediately drawn to the Unit's 5,0kW CO_2 laser, which although on-show was being used for a production run of a BMW undercarriage component. The niche of this particular laser is its 3D capability. It is in routine use for small production runs for: 3D edge-trimming and final hole cutting of pre-pressed parts. The big advantage of machining a 3D-pressing is that perfect consistency can be achieved every time. I was drawn to ask about the jigging involved to achieve this level of precision. Specialised software available at the NLC provides a jig design and manufacturing capability. Jig designs for the laser cutting bed are generated to give best access to the cutting paths required. The jigs are then manufactured by the laser, which profiles sets of flat interlocking plates that are fitted together to give a 3D support structure for the part. The laser even engraves an assembly-part number on every piece so that it can be easily slotted together once cut. I watched pressing after pressing being loaded into the laser and identical finished parts being unloaded – and the only anxiety being expressed was whether the ordered nitrogen would arrive in time.

The NLC, along with its Materials Processing group, was set up just 10 years ago, to support South African industry in implementing laser technology and today, "... this unit is the most interactive with industry," says Ndumiso Cingo, the CSIR NLC manager, in a short introduction to the day's proceedings. The aim of the open day? "To show what Laser Technology has to offer, particularly for the manufacturing sector of South African Industry."

An overview of the NLC's activities follows, presented by Isabel van Rooyen, the competency area manager for the Materials Processing group. "The NLC's turnover is R50-million, of which 30% is funded through internal CSIR grants and 70% is raised through contract research proposals and services," she tells us. It has three competence areas: the Laser Physics and Technology group; the Laser Materials Processing group, hosts of the day; and the Higher Education Institute, which was set up to make lasers more accessible to university students.

According to van Rooyen, the Laser Materials Processing group's ambition is to "research and develop laser based manufacturing techniques for different materials; to develop and maintain local technological expertise; to promote industrial competitiveness; and scarce skills development. We support local industry as a centre of excellence for laser-based manufacturing."

Van Rooyen talks of a push strategy linking basic and applied research. By creating awareness of laser-based manufacturing technology and through developing relationships with potential laser users, specific application opportunities and manufacturing techniques can be identified.

The need for highly precise fit-up prior to welding can be overcome by changing the joint design.

The potential of these can be established via feasibility studies and manufacturing solutions. "And we also provide specialised production services," she adds. "We use our laser equipment to process real components for industry."

But the pure research side is also important: "It is not helpful simply to maintain the knowledge base, we must further our knowledge. We must keep in touch with new developments so that we can provide an upfront service to introduce new technology," she suggests, "and through all of these processes, youngsters are being developed who have up-to-date laser knowledge and experience that can be directly used in future careers."

Moving onto creating awareness of what laser technology has to offer, Van Rooyen introduces Charl Smal, one of two International Welding engineers on the group's staff.

From a material's processing point of view, the key advantage of using a laser is that its light source can be focused – and the better the focus the better the processing: "Energy density is the name of the game," says Smal.

For welding, a laser comes into its own because the energy can be so concentrated that a cylindrical fusion zone can be created to melt right through the thickness of the joint. "10kW can be concentrated on 1mm^2. In fact, the focus is so sharp, typically within a 50µ radius, that we have fit-up gap problems. On plates less than 3,0mm thick, the maximum allowable gap is 10% of the plate thickness, ie. 300µ on 3,0mm plate. On thicker plate, this reduces to 5%, so when butt-welding on 30mm material, the joints should be aligned to within 1,5mm," he warns. This problem can be overcome to a great extent, by changing the joint design, by using a machined overlapping joint arrangement, for example, and then laser welding through both thicknesses.

Laser cladding offers excellent process control.

The key benefit of high heat intensity, says Smal, is low distortion. He shows us a graph of the deformation resulting from different welding processes. The best (lowest distortion levels) are achieved by using electron beam welding, but laser-welding is not significantly far behind. MIG and submerged arc welding, in contrast, produce in the order of 10 times more distortion and often have to be re-machined after welding to restore dimensional accuracy. "As a ball park figure, a laser uses about 10% of the energy that an arc welding process will use, ie, the heat input is reduced by a factor of 9," explains Smal.

Another key advantage of lasers, linked directly to their deep-penetration ability, is the opportunity to complete a full penetration weld with access to only one side of the joint. Also, close proximity to the joint is not required, which makes for more flexible automation and reduced clash risks. The smaller fusion and heat affected zones also mean that much less material is microstucturally changed by the welding process.

The disadvantages? The cost of the capital equipment and increased preparation costs to achieve the joint precision required. But Small believes that the high productivity gains of using a laser – welding speeds of 10-12m/min are possible – along with better consistency and weld quality, often make the investment worthwhile.

Maritha Theron is the next laser specialist to present. Her expertise is on laser transformation hardening, a technique used to obtain a hard and wear resistant surface layer, typically in the order of 0,5-1,5mm thick, by transforming the microstructure of a carbon steel to martensite. The principle is simple, you use a laser to irradiate the surface for short periods of time, and depending on the wavelength of the laser used, the absorptivity of the metal surface, and the travel speed of the laser beam, heat transfer takes place

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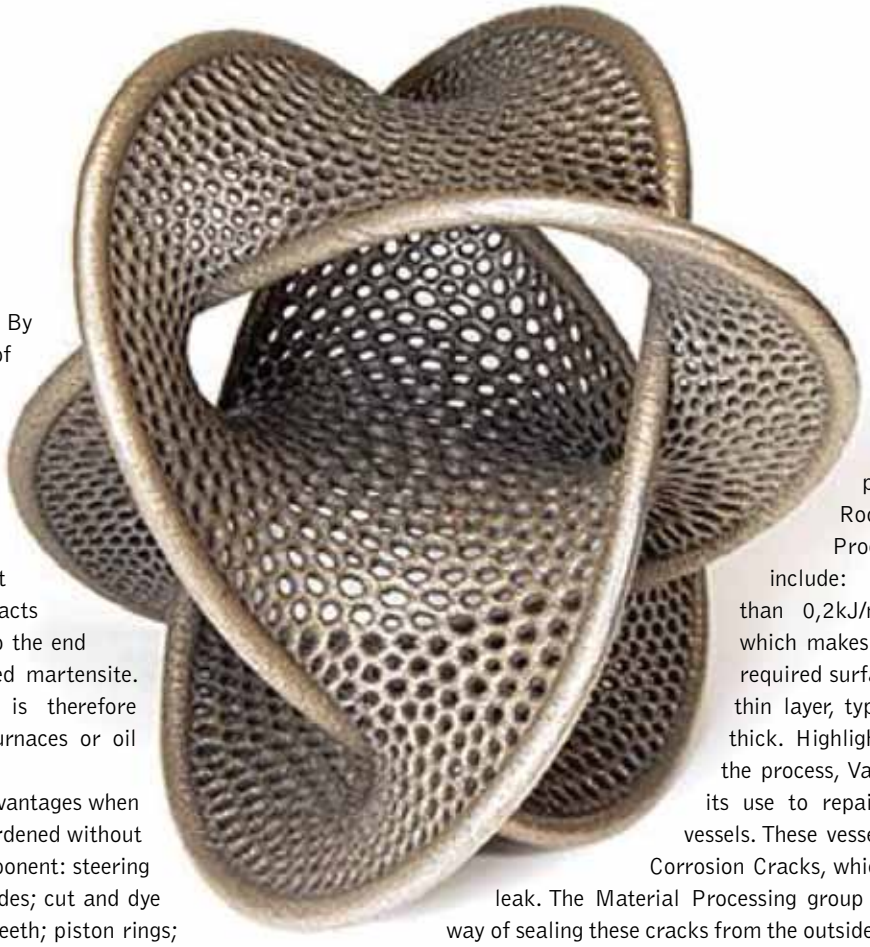

via conduction in the steel. By raising the temperature of the surface sufficiently to completely transform the microstructure of a thin layer to austenite, and then allowing the bulk of the material to conduct that heat away at a sufficient cooling rate, the material acts as an effective quenchant so the end result is a layer of hardened martensite. Localised heat treatment is therefore possible without burners, furnaces or oil baths.

This process has major advantages when selected areas need to be hardened without affecting the bulk of a component: steering gear assemblies; turbine blades; cut and dye edges; cam followers; gear teeth; piston rings; plastic injection moulds; cylinder liners for diesel engines; tool steel; bearing surfaces; and shafts.

It is an automatic process and therefore easily integrated with other processes on a production line. In comparison to traditional techniques, it has quick turnaround times, and it gives an accurate and repeatable depth of hardening. It is also possible to achieve 20% higher hardness by using a laser instead of traditional quenching processes.

Both the CSIR's 5,0kW CO_2 laser and its 4,4kW fibre-coupled YAG laser can be used for the process: "When using the CO_2 lasers, with their longer wavelength, we need to coat the surface with graphite to improve the absorption index and therefore the heat transfer," explains Theron, "but this is not necessary with the YAG laser."

Two methods are possible: a 12mm single spot method for small areas; and a scanned track method, which uses a scanning mirror to sweep the laser beam at high speed across the hardening path to create a rectangular profile of up to 25mm wide. The technology, while commercially available, is one of the group's service offerings: "If you have a requirement, we can assist with process development and procurement of suitable equipment," Theron concludes.

Corney van Rooyen, an International Welding engineer in the Materials Procession group, then presents on his specialist subject, laser cladding. "A focused laser beam creates a shallow weld pool and powdered or wire material is added to that pool to create build up," he explains simply. "The process fits nicely between the Plasma Transferred Arc (PTA) cladding and the thermal spray processes. Like PTA, though, laser cladding is a fusion process, ie, there is a metallurgical bond between the workpiece and the clad layer. Thermal spraying is a mechanical bonding process," says Van Rooyen.

Process characteristics include: low heat input, less than 0,2kJ/mm, and low dilution, which makes it easier to achieve the required surface chemistry in a single thin layer, typically half a millimetre thick. Highlighting the advantages of the process, Van Rooyen tells us about its use to repair some stainless water vessels. These vessels had developed Stress Corrosion Cracks, which were causing them to leak. The Material Processing group was asked to develop a way of sealing these cracks from the outside without emptying tanks. "It is very difficult to weld a seam that has water squirting out with conventional processes. You end up with porosity," he explains. "But by using the laser cladding process, even though water was pouring through the cracks being welded, we were able to contain the weld pool and seal the cracks without having to drain the tanks."

As a result of this successful trial, the group has now developed a technique for repairing all of the tanks on site. A containerised YAG laser will be used, so that the laser beam can be transmitted to each tank via a long fibre-optic conduit, and a mobile space frame has been developed to carry the laser welding head along the paths of the cracks.

According to Van Rooyen, laser cladding offers excellent process control: low heat input; low energy per unit length; low dilution; high repeatability; and high precision. It can be used to deposit very accurate layer thicknesses in a wide range of corrosion and wear-resistant materials.

The highlight of the day was the presentation by the group's research group leader, Herman Burger, on additive manufacturing. Laser enabled additive manufacturing, Burger believes, "gives a glimpse of the future and perhaps into the future of manufacturing in general."

Normal machining processes are subtractive in nature, ie, components are manufactured by removing material using a cutting tool until the part is the size and shape required. In contrast, with additive manufacturing "you start off with nothing and you build the part layer by layer – and magic is revealed when you introduce a laser into this process." It allows precise fusing of powder onto previous layers until the finished geometry is realised. By dividing the

part into a number of thin cross-sections, a laser additive tool path can be generated, enabling a direct leap from a CAD model to a fully functional part.

There are two basic additive manufacturing methods. The first, the powder bed method, is similar to some of the rapid prototyping methods used to make plastic prototypes. A very thin layer of fusible powder is spread uniformly over a flat build platform. The laser beam, directed by a reflective mirror, is scanned over this first layer according to the tool path for the layer, fusing the powder into a solid base layer. Then the table drops down by one layer thickness, a new layer of powder is spread and the next layer fused.

The second, the blown powder technology (BPT), or laser metal deposition (LMD) method is similar to laser cladding. The powder is fed via a nozzle into a melt pool created by a fixed laser. The component is translated around a 2D tool path under CNC control below the fixed laser. The powder fuses as the weld pool solidifies and the layer is complete as soon as the tool path has covered the area of that section. Then a new layer is started and the build-up continues.

The two processes are essentially complementary and useful for different sets of applications: "The BPT method is suitable for a far greater range of materials and a lot of our cladding technology experience is relevant," says Burger. The powder bed method is more bound to the system manufacturers, who develop their own powders and processes to suit their machine designs.

The major difference is that the BPT method can be used to build very big parts, (1500×500×500mm), while the powder bed method is limited to components in the 250×250×150mm range. The key advantage of the blown powder method, however, is that very complex parts are possible, "Powder bed technology is capable of thinner layers and therefore much finer detail. Dimensional accuracy of both technologies is in the 0,2-0,3mm range."

Although the additive process takes time, it eliminates the need for hard tooling and in many instances, particularly for high-value low-volume components, it can be a significant time and cost saver. Also, implementing design changes is easy and without tooling consequences. Large cost savings in terms of raw material consumption are also possible, which is important when expensive materials like titanium and superalloys are being used.

The big advantage for the future, though, is design freedom. "Some of the structures currently being demonstrated are difficult to manufacture using conventional methodologies. The possibilities are a challenge for the minds of people brought up in the conventional 'design for manufacturability' paradigm!" exclaims Burger.

Powder bed additive manufacturing expertise is fairly well established and available in South Africa from either the Central University of Technology (CUT) or the Vaal University of Technology (VUT). "Either of these institutions can be approached with requirements that you may have," says Burger.

"There is better news, though. While the blown powder method is not yet available in South Africa, that is about to change. We are about to invest in a state-of-the art BPT called LENS. Features include: a size capacity of 1500×900×900 mm; a hermetically sealed work space under full atmospheric control; a 5-axis table with X, Y, Z, tilt and rotation and a gas purification system that reduces oxygen levels to less than 10ppm. "We will also have the luxury of two powder feeders, which will allow us to change the material composition and chemistry at a programmable rate without having to stop the build," Burger points out. "This is a powerful technology," he concludes, "and we don't know where it will end. It may even revolutionise the way things are manufactured in the world."

I was recently asked by my own child, in that laconic and dismissive way that all children seem to adopt these days, "So what is it about lasers that makes them so special?" I am unashamed to have to admit that I was unable to come up with the one word 'aha' answer that would have satisfied

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Figures 1 and 2: Examples of design freedom offered by SLS.
Figure 3: The Trumpf CO_2 laser is routinely used for small production runs.

either of us, but it got me thinking. It's not about their power, nor about the visuals displayed at U2 or Jean Michel Jarre concerts; what lasers offer are precision, accuracy and control. Whether being used for cutting, welding, machining, hardening or additive manufacture, the end result is getting close to as precise as you can get. This precision is now increasingly necessary to manufacture the high-tech, high-quality goods demanded by modern consumers.

While I am now more inclined to get excited about buying a laser-based spirit level than a laser ray-gun, I believe that laser manufacturing tools have already changed the world we live in, and the opportunity offered by new additive manufacturing technology to make previously impossible designs a reality, will be taken up by several of the world's manufacturing nations. Let's hope South Africa is amongst them.

Figure 1: The jigs for 3D laser cutting are manufactured by the laser as sets of flat interlocking plates which are fitted together to give a 3D support structure for the part.

Figure 2: Trimmed and cut parts for a BMW under-carriage component.

Can backup systems handle **future growth**?

by Robert Brandt, Drive Control Corporation

South Africa's unstable electricity situation is well known, and while the load shedding incidents of 2008 are a hazy memory, the fact remains that power outages are more likely to occur in the years ahead while Eskom waits for new power generation capacity to come on stream. More dangerous than power outages are events known as brownouts, where power levels dip below voltage and can damage equipment over time.

Since economists are predicting that Eskom will find it difficult to maintain supply, particularly during 2011 and 2012, it is important for businesses to protect their expensive equipment investments using power backup systems such as generators and uninterrupted power supplies (UPS).

A UPS will help to ensure that equipment is protected from power fluctuations and the possibility of data loss from sudden outages or dirty power. However, organisations need to bear in mind that a UPS alone is generally not enough, as these devices do not run for longer than an hour and a half and the typical length of a power outage is between four and five hours.

If the UPS battery is completely drained it can take as long as a week to recharge fully so, if the power fails more than once a week, the run time of the UPS will be affected.

To deal with extended power outages a generator is often necessary. However, it on its own is also not sufficient to protect equipment, as even with automatic transfer switches to turn on the generator when mains power fails, there are a few seconds where the generator is warming up that power is lost, and this can cause loss or corruption of data and damage to equipment.

A UPS and a generator should work in tandem, with the UPS acting as a bridge between outlet power and generator power in times of failure. The UPS will protect data and equipment as the power switches to generator supply, ensuring continued productivity and data integrity.

Businesses should also take capacity growth into consideration. As an example, organisations may have invested in generator systems in 2008, and since that time have purchased extra equipment, more powerful computers and even upgraded UPS systems, all of which put extra load onto the generator when it is in use.

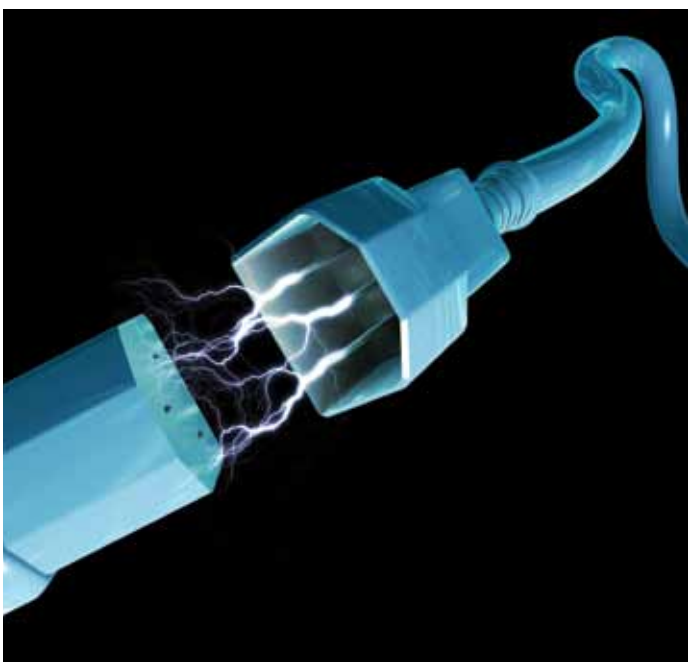
If growth was not taken into consideration during the initial purchase, the reality is that the generator capacity may no longer be able to withstand the required load. When the time comes for the generator to kick in, if the load exceeds capacity the generator will simply fail, leaving organisations open to data loss and equipment damage as well as lost productivity.

When purchasing any sort of power backup system, whether UPS or generator, it is advisable to upsize the equipment by at least 25%. Buying equipment for current needs is appealing to budgets, but could end up costing a lot more in future should capacity run out.

When purchasing a UPS it is important not to size using the standard VA rating given to these devices, as this represents assumed power rather than actual power. While devices from different vendors may have the same assumed power, the actual power output can differ considerably from product to product, and the actual wattage output of the device is a more accurate measure of its capacity.

This wattage is written on the packaging of the device and can be used to get an accurate determination of which device will suit the needs of a business now, with an added buffer for future growth.

With the on-going power problems in South Africa, a UPS is a vital piece of business equipment that needs to be kept current and up-to-date. Even when power supply is available it is subject to surges and spikes that can cause loss and damage, so a UPS with automatic voltage regulator that can provide battery backup, complemented by a generator that can handle the required capacity, are key to maintaining business productivity during power problems.



Earth Wire Monitor – EWM550

Profit and production are the key to your success.

However, if these are to be achieved by compromising on safety, then best you reconsider your business model.

The EWM550 is a unique device offering you increased peace of mind in the most hostile of operating environments.

It works with the electrical supply system to monitor and alert you to a deterioration of the earthing system allowing you to react before your production is affected – but protecting your plant and personnel in the case of a dangerous condition developing.

Features

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Contact: John Warwick • **Cell:** 083 230 1610 • **E-mail:** jvwarwick@gmail.com

JOJEN SUPPLIES

Back-up batteries that run on AIR

British-based company EnergetixPnu Power has developed a range of compressed air batteries as direct replacements for electric batteries that can be used for uninterrupted power supplies. Energetix says its batteries lower the carbon footprint of a company, lower maintenance costs and lead to reduced operating costs.

Supplied as what the company calls plug-and-play units from 3kW to 200kW, the batteries have been used by the National Grid in the UK and North America as well as by international telecommunications companies, and industrial manufacturers.

Pnu Power batteries have a small scroll generator or spiral pump used in superchargers and air conditioning units, but effectively running in reverse. The scroll drives a conventional generator to produce electricity on demand.

Ultra capacitors and sophisticated electronic controls ensure that the UPS unit delivers the battery power virtually instantaneously to wherever it is needed.

Pnu Power has developed several specialised units for use in specific applications. The IMVA Air-DRUPS uses a compressed air battery in place of a flywheel solution to provide backup power for larger applications. The containerised package includes a diesel generator and can be scaled up to 3MVA.

Pnu Power product manager, Andrew Goodwin claims that compressed air batteries are simply a "smarter choice" for most UPS applications. "Rotary flywheel-based systems have significant power losses in standby mode and normal batteries require regular maintenance to ensure reliable operation," says Goodwin.

"By contrast, compressed air batteries use negligible power on standby, are virtually maintenance free, with a minimum 20-year service life and are totally dependable," he says.

He claims these batteries "instantly deliver 100% of the UPS power" and greatly reduce the need for diesel generator starts that are caused by short duration outages.

MV substation on a truck

Schneider Electric South Africa has produced a complete MV mobile substation, fitted into a 12m container and mounted on a truck-trailer, to demonstrate its distribution solution for municipal, commercial and industrial applications.

The MV mobile substation allows operational demonstrations of the switchgear to take place on site. It was demonstrated at the recent annual conference of the Association of Municipal Electricity Undertakings (AMEU) held in Stellenbosch.

"The fitting of state-of-the-art equipment into the mobile substation projects the complete scope of the total MV solution offered by the company," claims Dudley Miller, energy business vice-president of Schneider Electric South Africa.

"All of the gear in the mobile substation is wired in and includes networking equipment that connects with a SCADA power suite through a T200 hardware interface controller from a laptop computer. It is a complete MV solution – from the incoming breaker through to the distribution ring main unit for underground cabling and MV auto-reclosers and sectionalisers for overhead wire transmission," he says.

The display includes Schneider Electric's GeniEvo, a compact, fixed pattern demountable configuration switchgear solution, suitable for both utility and municipal or even large industrial MV power supply requirements, as well as the Nu-Lec N-Series automatic circuit re-closers that combine high technology vacuum arc interruption with integrated voltage and current measurement all contained within a 316 stainless steel enclosure with SF6 gas insulator. The Nu-Lec N-Series offers intelligent switching with re-closers that have built-in load and source side voltage measurement, which ensures the network makes correct switching decisions within fractions of a second. Quick response to faults reduces maintenance and keeps outages to a minimum. The RL-Series load break switches, or sectionalisers, offer extremely short arcing times of within half a cycle.

Mentorship

The SAIEE is offering mentorship and advice to young engineers.

The offer comes at a time when our country is suffering a shortage of skills, and we believe that mentoring is an essential requirement in the training and development of the next generation of engineers.

If, as a member of SAIEE, you believe that you need a mentor you can request a mentorship service from the Institute.

The service will be of particular benefit to those young engineers working under the leadership of busy and pressurized engineers, who may not have the time to spend with the young engineers discussing and planning their career paths.

This service is particularly relevant to young engineers who are working in an environment devoid of engineers or with non technical managers. The young engineer may feel frustrated because he or she cannot benefit from the wisdom of an experienced engineer.

It will give a young engineer, the mentee, a chance to talk to a mentor, who will be his or her advisor, teacher and role model, away from the work environment. His or her mentor, matched to a similar profile, will understand the mentee's work and personal situation, having been there him- or herself.

The mentee will be able to discuss problems and frustrations with his independent mentor, who would have no stake in the outcome, and who would be able to provide an unbiased opinion and advice. The mentee might not be able to do so with his superiors, particularly if he is unhappy, and is considering an alternative career.

The mentor and mentee could arrange to meet regularly, but not too often, say a few times a year, when both should have enough time to listen properly to what the other has to say.

The mentor could recommend to the mentee what course of action to take without being too prescriptive while the final decision and the consequences remain with the mentee.

Among its more than 5000 members the SAIEE has many experienced engineers who are willing to act as mentors. They are are spread across the country and include engineers who are experienced in steelworks, furnaces, rolling mills, mining, manufacturing, electrical generation, transmission and distribution, through to light industrial, process control, instrumentation, telecommunication, robotics, automation, software development and engineering management of these sectors.

So if you feel that you would benefit by talking to a mentor, please contact Ansie Smith on the number below. She has a database to match the profiles of mentors and mentees.

Prospective SAIEE Mentors
If you feel you that you have the time and interest to help mentees, please contact Ansie Smith on smitha@saiee.org.za or 011 487 9050,
In addition you gain CPD credits, for when you are required to re-register.

Turn to the *seas* for ENERGY

Britain is to go ahead with plans to build a new tidal energy project in the Sound of Islay on the west coast of Scotland. An array of ten tidal turbines will generate enough electricity to power about 5 000 homes.

Scottish Power Renewables is behind the scheme and it will invest £40-million in installing the tidal turbines of Islay where extremely strong tidal flows frequently occur.

According to Keith Anderson, chief executive of Scottish Power Renewables, the approval of the tidal turbine array means that the marine renewable energy sector has been given a significant boost. He says this is the first commercial tidal energy project to be undertaken anywhere in the world.

It could soon be dwarfed by a much larger project that is planned for Pentland Firth where about 1 600 MW of tidal energy can be generated.

The scheme will use the Hammerfest Strom tidal turbines, which have been tested as a generating prototype in Norwegian waters for the past six years.

These Hammerfest Strom turbines are currently also being tested in Orkney and, according to the European Marine Energy Centre's Neil Kermonde, construction on this new power project will start early next year.

So while Scottish Renewables will effectively operate the first tidal turbine array, European Marine Energy Centre will be the first company to produce a significant amount of renewable energy from tidal resources.

Kermonde says the significant point is that a major renewables energy company has "voted with its cheque book" and is putting its own money behind tidal energy generation.

Britain is seen as the world's leader in tidal energy and the country is investing heavily in the future of this technology.

Image: Hammerfest Strøm.

BIG boost for **Eskom** wind, solar plants

The African Development Bank may lend South African power utility Eskom $270m (R1.9bn) to fund its wind and solar power projects. This is according to the Southern African Alternative Energy Association (SAAEA).

Hela Cheikhrouhou, the bank's climate change and energy director, said recently that the bank would mediate an additional $100m from the World Bank's Clean Technology Fund. "The AfDB expects to channel up to $370m loan from its own resources and from the (World Bank's) Clean Technology Fund," she said in an emailed response to questions.

The total $370m would be used to help fund Eskom's proposed Sere wind farm, expected to produce up to 200MW and the utility's planned 100MW concentrated solar power plant. Cheikhrouhou said the bank expects to take the loan to its board for approval by the end of June.

Eskom may get additional loans from development finance institutions such as the KfW, Agence Francaise de Developpement and the European Investment Bank for the two plants, she added.

According to Cheikhrouhou, the AfDB may also support at least one project under South Africa's renewable energy feed-in-tariff programme and provide credit lines for renewable and energy efficiency projects to local banks.

The AfDB is advising the DRC government on the development of the Inga hydropower project on the Congo River and may support some other energy projects in the region. "We do expect to approve at least a couple of hundred million dollars in the sub-region on the energy sector in the 2011-13 period," Cheikhrouhou concluded.

Dear Paddy

Just a short note to thank you for continually putting together such a readable, relevant and enlightening publication!

Much appreciated,
Bruce Spottiswoode
Cape Universities Brain Imaging Centre
University of Stellenbosch

Hello Paddy Hartdegen

I would like to make some comments in reply to your article on Africa's darkness. I see myself as an optimist and I am greatly optimistic for Africa although I do see that its challenges are complex and large.

I refer to your observation about small scale photovoltaics in Ghana. With the price of PV having come down considerably over the past few years and manufacturing capacity growing at a strong pace, PV is something I am keeping an eye on. On the down side, PV is relatively easy to steal off a roof and being an expensive item will be a great temptation for thieves. This problem does, however, create another opportunity for engineers. What about PV panels with a built-in GPS unit or tracking device? Alternatively, roll-up, flexible PV panels could be put out in the sun in a safe place during the day and then rolled up and put away at night.

In terms of energy efficient lighting and cell-phone charging, PV represents a great opportunity. Having undertaken several electrification projects in Khayelitsha and the Transkei, I noticed how quickly people plugged in their cell-phone chargers once an area was 'switched on'.

An alternative energy solution for Africa that I discovered by following someone on Twitter is the rocket stove. It burns wood efficiently and may be an interim solution in certain rural areas. Wood burning is carbon neutral if the wood is obtained from a sustainable forest. A great development advantage for Africa is that other parts of the world have already gone through the learning curve and we don't need to re-invent the wheel. We do, however, need to keep our thinking caps on, keep our eyes open and find appropriate technologies that are practical to implement and sustain.

After Ghana's final soccer game in the 2010 FIFA World Cup South Africa, I made the comment that Africa's hope is not Ghana. We will soon see the light shining brightly in Africa.

Sincerely
Bruce Munnings

Dear Paddy,

I would like to support the comments by Mr Don Andrews (published in the Dec 2010 Issue of WATT NOW).

The CPD point scheme is a Gravy Train onto which certain companies have jumped in an effort to enrich themselves.

The amount payable for a course is extreme. If the company that employs an individual is not paying or subsidising the course applied for, it is almost impossible to register. In fact, I am aware of companies that are reluctant to send their staff on CPD courses, not due to the time away from office, but due to the financial impact.

I wrote a letter to ECSA in 2007, regarding this matter, to which they did not even bother responding.

I registered for, and attended, some of these courses, and in my opinion, the facilities, the lectures, the reading material and the food and beverages, did not at all represent the cost payable by each delegate. Not even considering those individuals who needed to fly or travel far to attend.

In my opinion, the purpose of enriching oneself with knowledge is not only to the benefit of the individual, but also the industry, the economy and the country as a whole. It should therefore not be an expensive policing system, penalised by the Engineering Organisations for Non-attendance. A reasonable fee should be regulated, for all to be able to afford. One should look forward to attending such courses, not see them as a burden.

I am confident that if the figures were published of those individuals, like Mr Don Andrews, who ceased to keep up their membership, it would be clear that this scheme is heading for a disaster and an even further decline of knowledgeable professionals.

And quite frankly, it makes one wonder why the membership fees rise so much each year. Is it perhaps because fewer paid up members are obliged to carry the same budget? Makes you think, doesn't it ... ?

Regards,
Pine Pienaar
Professional Engineering Technician
SAIEE member

Dear Paddy

It is not the answer that enlightens, but the question.

Regards,
Hennie Botes
Moladi

To contact our Editor at WATTnow Magazine with your comments, please email Paddy on paddyh@crown.co.za

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2. A series of DVD recordings of lectures/conferences held throughout South Africa also provide CPD credits by answering appropriate questions.

4. A simple, quick and efficient online answering system via the **WATTnow** website for subscribers to submit answers to CPD questions makes this method of acquiring credits easy and convenient.

5. A complete administrative system to ensure that credits acquired are correctly recorded and available to all subscribers.

6. Subscribers to the **WATTnow** CPD Programme receive an annual certificate from the SAIEE detailing credits obtained in a calendar year.

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Engineering the future – relevance of the **SAIEE** in our contemporary times

2011 Presidential Address by Andries Tshabalala, FSAIEE

The South African Institute of Electrical Engineers (SAIEE) is a learned society that is more than a hundred years old. It boasts of approximately 5400 voluntary members with its headquarters based in Johannesburg, South Africa. The SAIEE is recognised as a voluntary association by the statutory Engineering Council of South Africa (ECSA). It is governed in accordance with its constitution under the leadership of its elected Council. The Council is responsible for the day-to-day running of the Institute in the best interest of its membership.

For the 2011 year of tenure, the President has elected to further develop last year's theme, Engineering the future, by emphasising the relevance of the SAIEE in our contemporary times. Indeed, we live in times when it is great to be an engineer. We are called to come up with solutions to challenges facing our time, using the laws of physics to solve problems facing our society. Our training as engineers, founded on methodical analysis of problems leading to logically reasoned solutions, presents us as ideal solution providers to our society's challenges, even outside our disciplines. We, therefore, constitute a valuable resource to modern society.

As the SAIEE, our relevance needs to be premised on the basis that we need to direct our efforts to challenges where we can make a clear difference. We therefore need to carefully identify areas where these challenges lie and direct our efforts thereto. These areas would include:

- Our members
- Transformational challenges of our country
- Climate change
- Renewable energy
- Development and retention of skills

The SAIEE is a growing organisation, with approximately 400 members joining us annually. Analysis of our membership has revealed that of the 5400 members, approximately 42% are under the age of 40. It is therefore important that the SAIEE identifies and meets the needs of this age group in terms of its activities. Mentoring, experiential training, professional development, financial assistance to further their studies, etc. are some of the important needs of this age. Our communication media need to be accommodative of this age group. We need to start talking to them via some of the social media such as Facebook, Twitter and Linked-in. Furthermore, 34% of our membership is black and 4.8% of our membership is female. How relevant are our activities to these groupings? Are we adding value to their careers? In terms of the racial demographics, the age group wherein the black members exceed the white members is 26 – 35 years. This is in line with output from engineering departments of our tertiary institutions and is encouraging as the trend is moving towards the demographics of our wider society. What more can we do in order to continue this trend? The year will see the completion of the extension project of our headquarters. The additional office space will result in cost savings in terms of having to hire space for council meetings and CPD events. We look forward to more members visiting the offices more frequently than before.

The Copenhagen Accord (2009) sets a non-binding objective of limiting the increase in global temperature to two degrees Celsius (2^0C) above pre-industrial levels in order to arrest the increasing trend of the global surface temperature. Now, according to the International Energy Agency (IEA), Power Generation is responsible for 41% of the Carbon Dioxide (CO_2) global emissions! Also, in accordance with IEA, China is the number one CO_2 emitter at 7711 million tons, whilst South Africa is at number 12 with 450 million tons. Clearly, most of our CO_2 emissions come from electricity generation where approximately 95% of our electricity comes from coal as a primary energy source. The SAIEE needs to understand climate change challenges and the commitment the country has made in the reduction of emissions over the next 25 years. This brings into question the choice of appropriate 'clean energy' (renewable) sources for our country. Also, what technologies are available to 'clean' the coal in order to reduce emissions from our existing coal fired power stations? More debate needs to take place on this.

Our Technology and Knowledge Leadership Committee resolved in 2010 that our Institute should focus on the following themes for the foreseeable future:

- Renewable energy and distributed energy resources
- Development and retention of skills

According to the US's PEW Research Center Report, in 2009, China invested $34.6bn in renewable energy, ranking number 1, whilst South Africa invested $125m, ranking number 17. In his 2011 State of the Nation Address, President Zuma says: "We must all save energy so that we do not have to resort to load shedding again as a saving

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measure. This year we will start procuring power from Renewable Energy Power Producers, which will demonstrate our commitment to renewable energy."

We need to ask ourselves: What can we do to help the Government overcome impediments to the realisation of this objective, including the regulatory environment review. What are the most suitable and cost effective solutions for our country? Through debates and presentation of papers we need to guide society to adopt the right technologies and educate them about most appropriate energy saving practices.

Electrical energy distribution has not received enough attention in the recent past in terms of investment. The focus has mainly been directed to electrical energy generation because of the shortages experienced early in 2008. Also, electrical energy distribution has lagged behind in receiving infrastructural investment due to lack of clarity on the future of the Electrical Distribution Industry (EDI). Now that a decision has been taken on the future of EDI, we need to help in the choice of appropriate technologies in this field, for example 'smart grid'. More debate needs to take place in this mammoth field.

In the New Growth Plan, Minister Patel states: "Target at least 30 000 additional engineers by 2014, changing subsidy formulae for universities as appropriate. Strengthen measures to ensure greater and more equitable access to science and maths education at secondary level and expand bridging programmes to tertiary courses." The biggest challenge facing our profession in the development of engineering skills is the availability of sufficient competent resources in teaching Mathematics and Physical Science at the basic education level and hence the quality of matriculation results in these key subjects. Out of the 537 543 students who wrote 2010 National Senior Certificate examinations 364 513 (67.8%) of them obtained a pass. However, 126 371 (23.51%) students, nationally, achieved a pass to do a bachelors degree. Overall, 124 749 students passed Mathematics whilst 98 260 passed Physical Science. It should be noted that 81 278 students (30.9%) and 60 993 students (29.7%) of those who wrote, passed Mathematics and Physical Science, respectively, at 40% and above.

One can then conclude that less than 60 993 2010 matriculants could gain entry to do engineering at universities. This demonstrates that our skills' challenge primarily lies in the basic education level. The SAIEE will need to continue finding ways and means, with stakeholders, to address this teaching and learning challenge at basic education level to ensure that more students with Mathematics and Physical Science are produced at matriculation level.

I have listed a few topics that I need every member of the SAIEE to focus on this year and I am confident of your unequivocal support. As a learned society, let us rally together and tackle the challenges facing our contemporary society. There is a lot of work to be done and electrical engineers have a lot to offer. Let us shed the perception out there that we are an 'old boys club'. We are indeed relevant!

Meet Andries Tshabalala, FSAIEE

Mr Mpila Andries Tshabalala, B.Sc.Eng.(Elec) (Natal), MDP (UNISA), CompIRSE, FSAIEE, was born in Standerton, received his primary education in Thokoza (Alberton) and obtained his technical matric at Edendale Technical College, in Pietermaritzburg. Whilst waiting for the Government permit to study engineering at a 'white university', Andries studied mathematics, Physics, Chemistry and Applied Mathematics for two years at the University of Zululand. He graduated in B.Sc.Eng.(Elec) (1983) at the University of Natal, now called University of KwaZulu-Natal, specialising in Electrical Machines.

Andries Tshabalala was first elected to the Council of the SAIEE in 2006. He is a Fellow of the SAIEE and has served on various committees and as Chairman of the Transformation Committee during 2007 to 2008 and Chairman of the Finance Committee for 2010. He was elected President of the SAIEE for 2011.

Andries joined GEC South Africa, now called ACTOM (Pty) Ltd, in 1976, worked for a year and was then awarded a GEC South Africa bursary in 1977 that enabled him to complete his university education. He re-joined GEC South Africa in 1983 as a junior motor designer in Benoni. As part of his engineer-in-training (EIT) programme, Andries spent 1985 working for various GEC companies in the UK. He served as GEC Small Machines Chief Electrical designer for six years. He became the Group Commercial Director, Divisional Managing Director for the Rail Transport division for 10 years and currently occupies the position of Group Executive Director: Strategy. He is a non-executive director for Alstom Power Service (Pty) Ltd, Alstom S&E (Pty) Ltd, ACTOM Namibia (Pty) Ltd and other private companies. He is also a Board Member of the Rail Road Association of South Africa (RRA) and was its President in 2008.

Andries participated in the formation of City Power Johannesburg (Pty) Ltd in terms of the City's Igoli2002 Plan, having served as Chairman of the Advisory Board in 2000 and was appointed its first Chairman of the Board of Directors from 2001 to 2003. From 2003 to 2005 he chaired the Board of Johannesburg Water (Pty) Ltd.

In 1985 Andries published a research paper that he co-authored with Prof RG Harley entitled: 'Induction motor behaviour in the presence of unbalanced supply voltages', which was published by the SAIEE and awarded the Eskom Award.

His recreational interests include walking, soccer, gym and watching wild life documentaries. He is married to Fikile, a teacher and they were blessed with two children, a girl and a boy.

Knysna: Turbine Hotel, Thesen's Island

Text and pictures by Les Stuart

Situated in the Knysna Estuary and earlier known as Paarden Island, Thesen's Island was re-named after its long-time owner Charles William Thesen, a Norwegian who arrived in Knysna with his family in 1870 and established several businesses.

Thesen & Co bought Paarden Island in 1904 and began processing timber on the land in 1922. Thesen's Sawmills Company Limited built the power station and, using wood waste from the timber mill as fuel to generate steam to drive the power station turbines, generated electricity initially for the timber mill only. The earliest boiler is dated 1909.

In 1929, they supplied power to Knysna for general use and street lighting and later also to Plettenberg Bay. The generating capacity was steadily increased as demand increased, and one of the commissioning plaques on display is from Brush Electrical, dated 1923.

This continued until the mid 1970s, when Eskom took over the distribution of electrical power to municipalities in the Southern Cape.

Industrial conglomerate, Barlow Rand (now Barloworld), purchased Thesen's logging and sawmill operation in 1974, including the power station, but the mill was decommissioned in June 2001 because of its adverse environmental impact. Thesen's Island was then sold off to a development company which built luxury houses and created Thesen Harbour Town, which included the old power station building. In a visionary plan for the island, a boutique hotel was established in and around the power station, incorporating as much of the installed equipment as possible. The Turbine Hotel opened in August 2010 and it is fascinating to see how the architect has incorporated the reception, restaurant, bars and conference facilities into the existing power station, amongst the machinery and

control panels that were retained in position over three levels! The generating plant consists of five turbine generators, with a combined total supply of about 10MW. The largest unit is rated at 2500kVA, while three tandem generators are rated at 1875kVA each. These three are thought to have been assembled in Grahamstown in 1923, before being purchased by Thesens in the 1940s.

Hundreds of smaller items of equipment have been incorporated into the décor of this heritage edifice, in a tasteful and practical manner, making a tour of the building a fascinating experience.

This article forms part of a series, 'Early power stations in the Southern Cape'.

All the old machinery, with its retro dials, pressure gauges and switches, has been refurbished and preserved at the new Turbine Hotel in Knysna.

Continued Professional Development

SAIEE Courses

PROTECTION FUNDAMENTALS was the topic of our most recent CPD course presented by highly respected and experienced lecturer, John Michel Smith. The event will be repeated in April to accommodate the overflow of bookings for this popular course.

Delegates at the Protection Fundamentals course.

A new course, LV VARIABLE FREQUENCY CONTROL, has been added to the SAIEE's list of CPD courses. The course, written and presented by Chris Conroy, was extremely well received by all who attended. It was observed by one of the SAIEE's Past Presidents, Mike Crouch, who recorded a glowing report.

The SAIEE's Mike Crouch (left) congratulating Chris Conroy on an exceptional course.

SAIEE forthcoming events

Members should diarise the following upcoming CPD validated courses:

Date : 6/4/2011
Event : *ELECTRIC POWER CABLES*
1 CPD credit
Venue : Johannesburg

Date : 13/4/2011
Event : *PROTECTION FUNDAMENTALS*
1 CPD credit
Venue : Johannesburg

Date : 10-12/5/2011
Event : CPD COURSE – to be confirmed
Venue : Durban

Date : 31/3/2011
Event : *FINANCE ESSENTIALS FOR ENGINEERS*
2 CPD credits
Venue : Johannesburg

Date : 8-9/6/2011
Event : *TECHNICAL DOCUMENT WRITING FOR ENGINEERS*
2 CPD credits
Venue : Johannesburg

Date : 14-15/6/2011
Event : *TECHNICAL DOCUMENT WRITING FOR ENGINEERS*
2 CPD credits
Venue : Bloemfontein

Info : Contact Sue Moseley on 011 487 9047 (suem@saiee.org.za) or Craig Smith on 011 487 9042 (craigs@saiee.org.za) should you need any further information regarding the SAIEE's CPD course programme.















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