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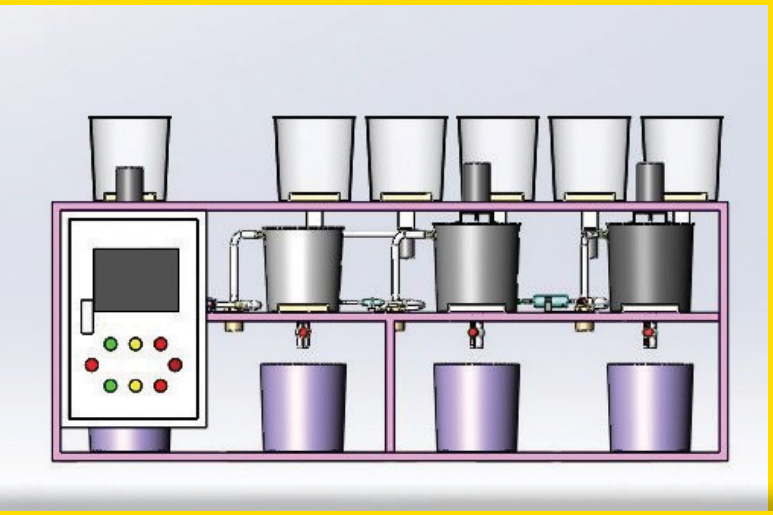
COVER STORY:

Lithium-ion battery rejuvenation technology solution created in Singapore



PLUS

RAILWAY & ROAD ENGINEERING (MECHANICAL & ELECTRICAL): Saving energy in rolling stock
SUSTAINABILITY: Construction of floating solar photovoltaic system commences
PROJECT APPLICATION: From failure analysis to gearbox design

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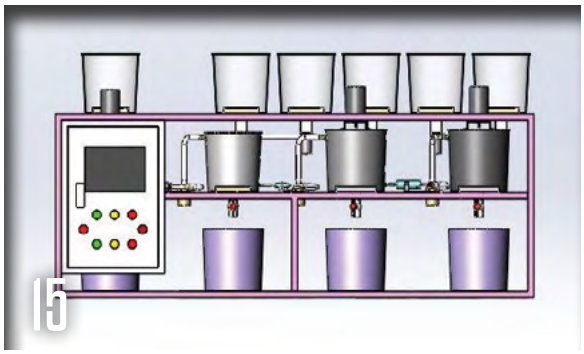

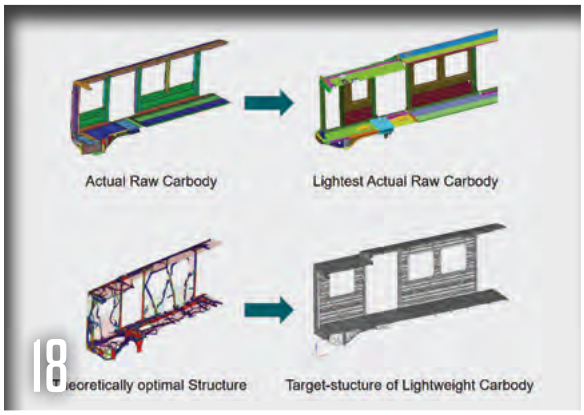

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DIGITALISATION

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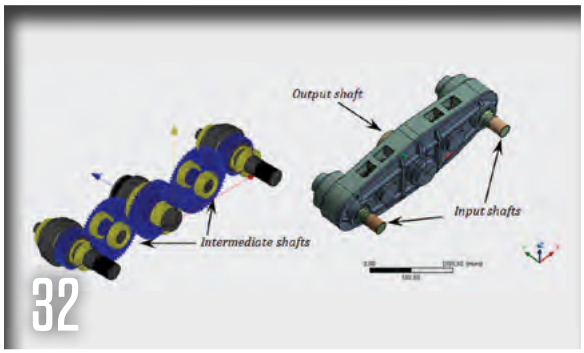

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HP TO EMPOWER 10,000 YOUTHS IN SOUTHEAST ASIA WITH 'SKILLS OF THE FUTURE'

Earlier this year, HP Inc announced plans to open 20 Tech Hubs in underserved communities across Southeast Asia by the end of 2020. The programme provides technology and entrepreneurship training for students aged 13 and above, and aims to upskill 10,000 youth by year-end - a goal that maps to HP's commitment to enabling better learning outcomes for 100 million people by 2025. This is outlined in HP's 2019 Sustainable Impact Report.

Outfitted with 15 to 20 new PCs as well as networking support from HP, the HP Tech Hubs blend classroom and online learning to deliver technical and soft skills essential for youths to thrive. These include Microsoft Office, coding, business communications, having a success mindset, and how to start a small business - taught by instructors or accessible online. Courses in entrepreneurship are adapted from HP LIFE, a free HP Foundation programme that offers modules on entrepreneurship, marketing and business development. The students will be awarded certifications for the courses they complete.

"Unprecedented connectivity, new technological breakthroughs, and now COVID 19, have re-defined how we live, work, and relate to one another. HP has a responsibility to play a role in preparing our youths for this new reality. To help them thrive in the new future of work, we need to build up their confidence, impart them the skills, and give them access to equal opportunities. Through the HP Tech Hubs, we equip youths in underserved communities with technical and practical knowledge and aim to inspire them to widen their horizons, be creative, and take the bold step towards new possibilities", said Ng Tian Chong, Managing Director, Greater Asia, HP Inc.

Six Tech Hubs have already been established in Lombok and Jakarta in Indonesia, as well as Kuala Lumpur in Malaysia. The remaining hubs are planned in Malaysia, Indonesia, Thailand, Vietnam, and the Philippines by the end of the year.

Enabling better learning outcomes

HP Tech Hubs are part of the company's broader education initiatives in Asia-Pacific, which have benefitted 1.3 million students and adult learners in 2019. These initiatives include:

- HP LIFE: Since its launch in 2016, HP LIFE has enrolled over 214,000 users globally. In Asia-Pacific, over 20,600 learners have accessed HP LIFE curriculum in 28 countries.
- World on Wheels: Since 2017, the World on Wheels (WOW) programme has rolled out 43 self-contained, Internet-enabled, solar-powered mobile learning labs in rural India, providing access to technology and learning to an estimated 3.5 million people in more than 1,400 villages.
- Little Makers Challenge: Tailored for parents, teachers, and 5- to 12-year-old children, to teach, play and learn creatively together through printed and online material, this initiative in Malaysia received over 18,600 submissions, representing an estimated 90,000 hours of activities covering subjects such as arts, geography, biology, and astronomy.
- HP-NTU Digital Manufacturing Lab: Founded in collaboration with Nanyang Technological University (NTU) and National Research Foundation Singapore, this lab is driving the development of innovation, technologies and skills to democratise digital manufacturing. In January, it introduced a skills development programme aimed at helping Singapore train and upskill talent in digital manufacturing.

Driving a low carbon economy

To accelerate the shift to a more efficient, circular, low-carbon economy, HP is committing to the global goal of eliminating 75% of single-use plastic packaging by 2025. Three hundred million tonnes of plastics are produced each year worldwide, half of which is for single use and 91% is not recycled at all. An activity that is experiencing an increase in demand, as a result of COVID-19, is packaging which, however, contributes to a significant proportion of total waste produced and can affect the health of the planet and people.

HP has made strides towards a circular economy in Asia-Pacific with local and regional programmes that are focused on reducing plastic waste, increasing the use of recycled materials, and restoring and protecting forests.

HP Tech Hubs are part of the company's broader education initiatives in Asia-Pacific, which have benefitted 1.3 million students and adult learners in 2019.

- Project STOP: HP joined Project STOP which collaborates with companies, governments and communities in Southeast Asia to create effective waste management systems that reduce ocean-bound plastics. In Muncar, East Java, Indonesia, Project STOP has set up Material Recovery Centers to collect, manage, and recycle plastic waste from more than 60,000 people, and they have generated over 100 full-time jobs. The waste collection service will be rolled out to more than 450,000 people across 55 villages in Muncar, Pasuruan and Jembrana over the next three years.
- Tidy Tech Kiwi: HP is tackling the problem of e-waste with the Tidy Tech Kiwi programme in New Zealand. In 2019, the programme successfully diverted over 8,000 kgs of e-waste from landfills and raised over USD 11,000 for seven schools.
- Straw Pallet Program: HP continues its use of recycled material for shipping HP inkjet printers with 52,000 pallets made out of 2,450 tons of straw from China in 2019. The straw would otherwise have been burnt as agricultural waste. Since 2017, more than 164,900 straw pallets have been used, diverting over 7,400 tons of straw.
- HP Sustainable Forest Collaborative: All HP-branded paper is already deforestation-free, and the company is on track to achieve, by end-2020, zero-deforestation for all its paper-based product packaging. To restore and improve the management of nearly 200,000 acres of forests in China and Brazil by end-2024, HP partnered with WWF in the HP Sustainable Forest Collaborative. In China, the project is focused on increasing the area of sustainably-managed forest plantations to improve their resiliency and biodiversity. New partners, including the Arbor Day Foundation, Chenming Paper, Domtar and New Leaf, have also joined the collaborative.

Embracing diversity and inclusion

HP is also driving a culture of diversity and inclusion at all levels of the company.

HP joined Project STOP which collaborates with companies, governments and communities in Southeast Asia to create effective waste management systems that reduce ocean-bound plastics.

HP Sustainable Forest Collaborative seeks to accelerate efforts on forest protection, restoration and management.

CHANGI AIRPORT INTRODUCES

CONTACTLESS MEASURES TO MAKE TRAVEL EXPERIENCE SAFER

In preparation for the resumption of air travel, Changi Airport will roll out several measures and innovations for a contactless travel experience.

At the airport's automated kiosks, new infra-red proximity sensors are being installed progressively to eliminate the need for travellers to touch the electronic screens when they check in or drop off their bags.

This will enable passengers to select options and key in their travel details by pointing their finger close to the screen without touching it. For those who need to check in at counters staffed by customer service agents, acrylic screens will provide a safe barrier between passengers and staff.

At the automated immigration lanes, ICA has installed a new biometric system that uses face and iris recognition technology as the primary means for identity verification. This replaces traditional fingerprint scanning.

To clean and disinfect the airport, the autonomous cleaning robots in the terminals have been upgraded with a nozzle that sprays a light disinfecting mist for added protection on carpets and floors during cleaning.

Changi Airport Group (CAG) is also testing the use of ultraviolet-C LEDs to disinfect the handrails of escalators and travellators in a safe way. A trial is also being conducted on the use of contactless infrared technology for passenger lifts, where travellers just need to hover their finger over the lift button to activate it.

These new contactless and cleaning innovations build on Changi Airport's previously introduced precautionary measures against COVID-19, such as temperature screening, safe distancing, use of masks by all passengers and staff, and use of sensor-activated "auto" hand sanitisers applying antimicrobial spray on frequently touched surfaces.

Mr Tan Lye Teck, Executive Vice President for Airport Management said, "Passengers will expect airports to deliver the highest standards of safety and hygiene to give them peace of mind during their journey, and we will rapidly bring on board new measures as we go into a new normal for air travel … CAG will work with other aviation partners to instill a high sense of confidence among travellers going through Changi Airport when air travel eventually resumes."

More than 160 automated kiosks across Terminals 1 and 3 will be fitted with proximity touch screens, with infrared sensors to track finger movements. Photo: Changi Airport Group

Autonomous cleaning robots used in Changi Airport's terminals have been equipped with a misting attachment that disinfects the carpets immediately after cleaning. This is in addition to daily carpet vacuuming undertaken by a separate set of cleaning robots equipped with a HEPA filter that catches fine particles while vacuuming. Photos: Changi Airport Group

ENSURING CONSISTENT CLIMATE CHANGE

RISK ASSESSMENTS AND DISCLOSURE

An Australian-first collaboration between climate scientists, insurers and the finance sector has produced new guidance for assessing the physical risks of climate change, such as tropical cyclones, bushfires and floods, to homes, buildings and critical infrastructure.

The Climate Measurement Standards Initiative (CMSI) has developed open-source voluntary guidelines that will provide Australian banks, financial institutions and insurers with scientific and technical guidance on how to assess the risk of damage to buildings and critical infrastructure, from extreme weather events.

The CMSI has been designed specifically to support the G20 Financial Stability Board's Task Force on Climate-Related Financial Disclosures (TCFD).

The Investor Group on Climate Change (IGCC) has played a key role in the development of these guidelines.

The guidelines produced through CMSI will help IGCC members to better assess their portfolio for physical risk, invest in resilience and respond through the TCFD.

Companies and organisations involved in developing the CMSI guidelines include QBE, Suncorp, IAG, RACQ, NAB, Westpac, Commonwealth Bank, HSBC Australia, Munich Re, Swiss Re, Leadenhall Capital Partners, MinterEllison, IGCC and Climate-KIC Australia.

Scientists from the CSIRO Climate Science Centre, Bureau of Meteorology, and leading universities under the auspices of the National Environmental Science Program's Earth Systems and Climate Change (ESCC) Hub have led the development of the science guidelines.

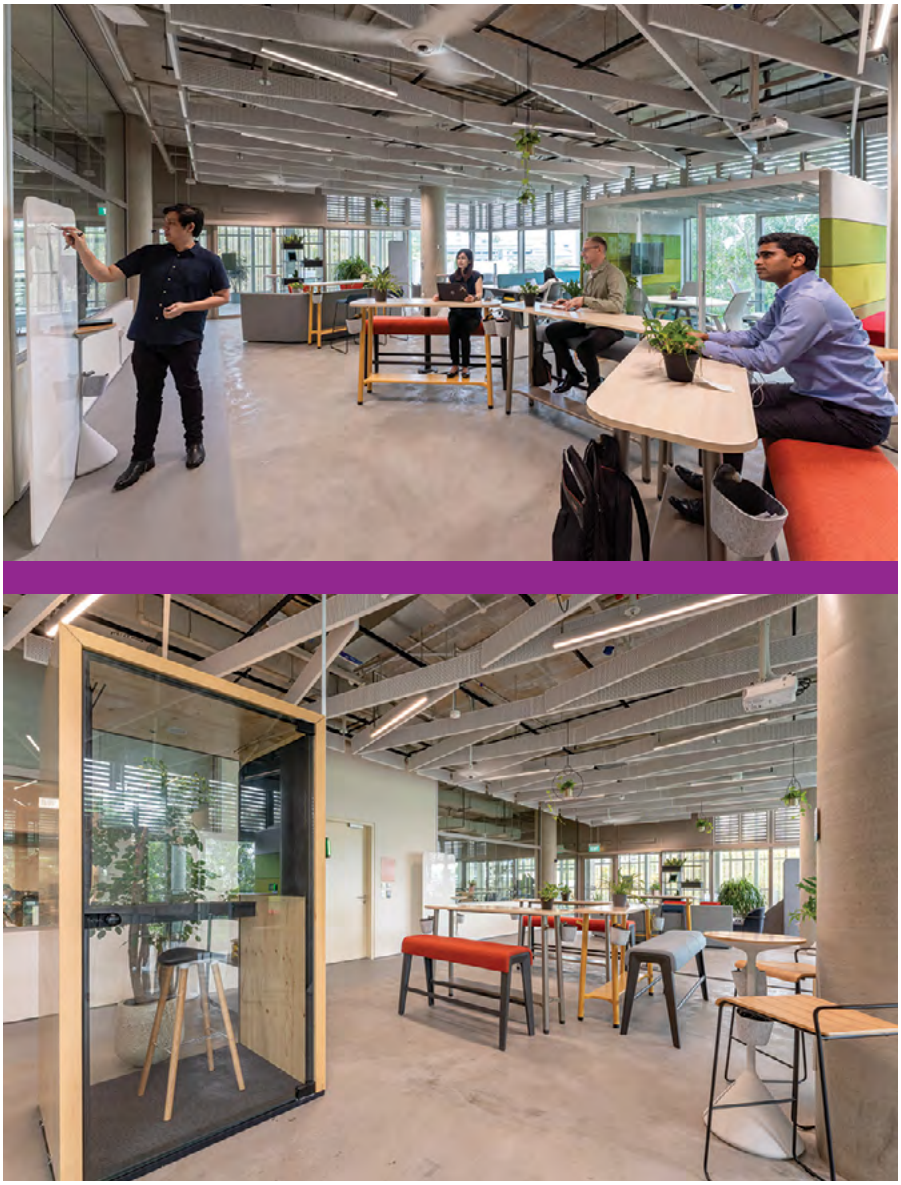
JOHNSON CONTROLS

OPENS INNOVATION CENTRE IN NUS

Johnson Controls, a global leader in smart and sustainable buildings, recently announced the opening of its SGD 50 million OpenBlue Innovation Center to create a future-ready built environment for Singapore and the region.

The facility, located within the School of Design and Environment (SDE), at the National University of Singapore (NUS), will be a living laboratory for a new breed of customisable, contact-free applications built on Johnson Controls' unifying technology suite, OpenBlue.

Together with its ecosystem of partners, which includes NUS and Microsoft, the centre is pioneering the use of a common configuration language that bridges core building technology with behavioural, wellness, and spatial data to develop solutions that meet new demands for safety and sustainability in connected spaces.



Johnson Controls' new OpenBlue Innovation Center, located within the School of Design and Environment (SDE) at the National University of Singapore (NUS), will be a living laboratory.

The 240 m² centre is housed in SDE4 which is Singapore's first new-build net-zero energy building. It will have sensors fitted throughout the indoor space, including for overhead ventilation and measurement of air flow, and on furniture to provide insights on occupants' alertness level. Engineers from the centre and collaborating NUS researchers will collect and analyse data using OpenBlue, leveraging artificial intelligence and analytics to obtain a qualitative and quantitative understanding of the interactions between technology, indoor environments and occupant well-being. The ecosystem of partners will tap on the intelligence generated from the centre to create evidence-backed solutions for healthier, safer, and connected indoor spaces.

Visal Leng, President, Building Solutions, Asia Pacific, Johnson Controls, said, "The Johnson Controls OpenBlue Innovation Center embodies our approach towards building dynamic and resilient spaces, injecting a new lease of life into the built environment sector. Taking an unprecedented holistic and human-centric methodology, we are incorporating people and design perspectives, thus sparking greater innovation within industries and outside traditional boundaries".

OpenBlue is a suite of connected platform, solutions and services that combines the company's 135 years of building expertise with cutting-edge digital technology. This open digital platform, when integrated with Johnson Controls core building systems and enhanced by ecosystem partners, connects traditionally separate systems to create new capabilities for safer, more agile, and sustainable space usage.

NUS will serve as a living laboratory for the OpenBlue Innovation Center's pioneering solutions, thus helping the university in its ongoing efforts to develop a smart, sustainable and safe campus for its staff and students. The collaboration also includes joint research and innovation in areas relating to the built and urban environment, particularly in data analytics, sustainability and operations, as well as people and wellness. There will also be opportunities for collaboration on teaching and internship programmes.

Professor Yong Kwet Yew, NUS Senior Vice President (Campus Infrastructure), said: "NUS and Johnson Controls have collaborated on several campus projects and we are therefore very excited to extend our partnership through these new initiatives which are part of our Smart, Safe and Sustainable Campus strategies. The opportunity to test Johnson Controls' novel solutions on our campus and conduct joint research will help advance our ongoing efforts to build smarter, healthier and sustainable work, teaching and learning spaces for our staff, faculty and students".

In 2008, Johnson Controls was the appointed partner to implement a converged campus building management solution for NUS University Town (UTown) which won the Green Mark Gold^{Plus} Award in 2010. Throughout the last 10 years, Johnson Controls introduced different technologies to enable the precinct to achieve energy savings of 20%. The latest remote maintenance capability introduced at UTown has also proven to be practical and crucial during the current pandemic conditions.

Professor Lam Khee Poh, Dean of NUS School of Design and Environment, said, "Our School of Design and Environment is thrilled to host the Johnson Controls' OpenBlue Innovation Center in SDE4 and to facilitate cross-disciplinary research and development initiatives across the entire NUS community. This partnership strengthens the school's 'Well & Green' vision that emphasises a people-centric integrated design approach to generate sustainable and resilient value propositions in its endeavours".

Johnson Controls announced the setup of the OpenBlue Innovation Center, with support from the Singapore Economic Development Board (EDB), in mid-2020. The facility is expected to have more than 100 employees within four years, with a strong focus on talent development with NUS at both undergraduate and post-graduate levels. The investment marks the company's commitment to spearhead the creation and adoption of disruptive solutions for the built environment industry in the region.

NEW FLEXIBLE SERVICE OFFERINGS POWERED BY OPENBLUE TECHNOLOGY

Johnson Controls recently announced that it will launch new tailored services that provide customisable solutions to its customers around the globe. These new service offerings will leverage the company's new OpenBlue technology to power remote and contactless services, in combination with its expertise in green building services.

The new services suite, available starting from October 2020, integrates touchless technology, sophisticated ventilation and sanitisation systems as well as a flexible infrastructure into digital offerings.

This allows a comprehensive range of HVAC, fire protection and security services to be monitored and managed remotely throughout normal, emergency, and pandemic circumstances.

Globally, the building services space presents a USD 150 billion opportunity that continues to grow across industries. Johnson Controls' direct footprint, with of over 16,000 experienced service technicians, gives the company the opportunity to address the servicing needs of its customers, and ensure safety, security, comfort, efficiency, and performance in an effective and timely manner.

Johnson Controls launched more than 20 new services in recent months, remaining at the forefront of innovation, with tailored solutions to meet and exceed customer needs.

The new tailored services suite is driven by artificial intelligence.

By providing more enhanced offerings, customers can select service tiers that best meet their needs from a comprehensive suite of service solutions across four tiers - Optimum, Expert, Enhanced or Essential.

Increased capabilities include remote HVAC, fire and security services; real-time 24/7 monitoring; and predictive analytics.

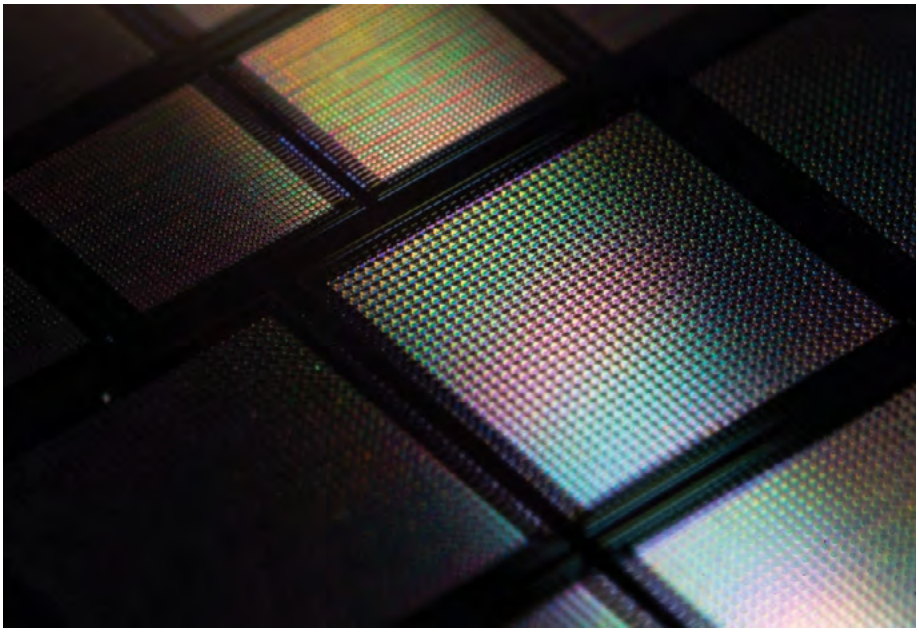
The service offerings are powered by OpenBlue digital technology. Key functions provide buildings with an environmental consciousness that is sustainable, efficient and more amenable for all occupants. Highlights include contact capabilities, touchless buildings, safe environments, and flexible infrastructure.

Additional details regarding the tailored service offerings and OpenBlue integrations across regions and countries are expected to be made available in the coming months.

ENGINEERS CREATE NEW MEMRISTOR DESIGN

USING METALLURGICAL PRINCIPLES

Borrowing from principles of metallurgy, MIT engineers have designed a memristor – silicon-based components that mimic the information-transmitting synapses in the human brain – that overcomes problems with data reproduction that is present in traditional designs.



A close-up view of a new neuromorphic "brain-on-a-chip" that includes tens of thousands of memristors, or memory transistors. Image: Lin Peng/MIT

Each memristor was fabricated from silver and copper alloys, along with silicon. Tens of thousands of them were patterned onto a chip, which was able to "remember" stored images and reproduce them many times over, in versions that were crisper and cleaner compared with existing memristor designs made with unalloyed elements.

Their results, published in the journal Nature Nanotechnology, demonstrate a promising new memristor design for neuromorphic devices – electronics that are based on a new type of circuit that processes information in a way that mimics the brain's neural architecture. Such circuits could be built into small, portable devices and would carry out complex computational tasks that only today's supercomputers can handle.

"So far, artificial synapse networks exist as software. We're trying to build real neural network hardware for portable artificial intelligence systems," said Assoc Prof Kim Jeehwan from MIT's mechanical engineering department.

"Imagine connecting a neuromorphic device to a camera on your car, and having it recognise lights and objects and make a decision immediately, without having to connect to the internet. We hope to use energy-efficient memristors to do those tasks on-site, in real-time."

Memristors, or memory transistors, are an essential element in neuromorphic computing. In a neuromorphic device, a memristor would serve as the transistor in a circuit, though its workings would more closely resemble a brain synapse – the junction between two neurons. The synapse receives signals from one neuron, in the form of ions, and sends a corresponding signal to the next neuron.

A transistor in a conventional circuit transmits information by switching between one of only two values, 0 and 1, and doing so only when the signal it receives, in the form of an electric current, is of a particular strength. In contrast, a memristor would work along a gradient, much like a synapse in the brain. The signal it produces would vary depending on the strength of the signal that it receives. This would enable a single memristor to have many values, and therefore carry out a far wider range of operations than binary transistors.

Like a brain synapse, a memristor would also be able to "remember" the value associated with a given current strength, and produce the exact same signal the next time it receives a similar current. This is a feat that normally involves multiple transistors and capacitors.

Ultimately, scientists envision that memristors would require far less chip real estate than conventional transistors, enabling powerful, portable computing devices that do not rely on supercomputers, or even connections to the Internet.

Existing designs, however, are limited in their performance. A single memristor is made of a positive and negative electrode, separated by a "switching medium," or space between the electrodes. When a voltage is applied to one electrode, ions from that electrode flow through the medium, forming a "conduction channel" to the other electrode.

The received ions make up the electrical signal that the memristor transmits through the circuit. The size of the ion channel (and the signal that the memristor ultimately

produces) should be proportional to the strength of the stimulating voltage.

Existing memristor designs work well in cases where voltage stimulates a large conduction channel, or a heavy flow of ions from one electrode to the other.

However, there is a lighter flow of ions between electrodes in the thinner conduction channels that are needed to generate subtler signals. This makes it harder for individual ions to stay together, causing them to wander from the group and disband within the medium.

As a result, it's difficult for the receiving electrode to reliably capture the same number of ions, and therefore transmit the same signal, when stimulated with a certain low range of current.

To get around this limitation, Prof Kim and his colleagues borrowed a technique from metallurgy.

"Traditionally, metallurgists try to add different atoms into a bulk matrix to strengthen materials, and we thought, why not tweak the atomic interactions in our memristor, and add some alloying element to control the movement of ions in our medium," he said.

Engineers typically use silver as the material for a memristor's positive electrode. After some review of existing literature, the team settled on copper as the ideal alloying element, as it is able to bind both with silver and silicon, and allow the ions to flow quickly between electrodes.

To make memristors using their new alloy, the group first fabricated a negative electrode out of silicon, then made a positive electrode by depositing a slight amount of copper, followed by a layer of silver. They sandwiched the two electrodes around an amorphous silicon medium. In this way, they patterned a millimeter-square silicon chip with tens of thousands of memristors.

As a first test of the chip, they recreated a gray-scale image of Captain America's shield. They equated each pixel in the image to a corresponding memristor in the chip and modulated the conductance of each memristor that was relative in strength to the colour in the corresponding pixel.

The chip produced the same crisp image of the shield, and was able to "remember" the image and reproduce it many times, compared with chips made of other materials.

The team also ran the chip through an image processing task, programming the memristors to alter an image in several specific ways, including sharpening and blurring the original image. Again, their design produced the reprogrammed images more reliably than existing designs.

"We would like to develop this technology further to have larger-scale arrays to do image recognition tasks. And some day, you might be able to carry around artificial brains to do these kinds of tasks, without connecting to supercomputers, the internet, or the cloud," noted Prof Kim.

HEARING LOSS IN THE SERVICES SECTOR

New research from the US National Institute for Occupational Safety and Health (NIOSH) estimates that a large number of noise-exposed workers within the services sector, the largest in American industry, have an elevated risk of hearing loss. The new study was recently published in the International Journal of Audiology.

Workers who are exposed to hazardous noise or chemicals that damage hearing can experience occupational hearing loss. Hazardous noise exposure is also associated with high blood pressure and high cholesterol. Hearing loss often co-occurs with tinnitus and is associated with depression and cognitive decline.

The mining, construction, and manufacturing sectors are recognized as having high percentages of workers exposed to hazardous noise, and are therefore at higher risk of hearing loss. Researchers have also identified sub-sectors within the services sector where workers were at a higher risk of suffering hearing loss.

These include newspaper, music and software publishing; renting and leasing; financial transactions; legal advice and representation; overseeing and managing governmental programs; security and surveillance; educational training; entertainment and recreation; accommodations and food service; machinery repairing; dry cleaning and laundry; and landscaping. Researchers examined audiograms for 1.9 million noise-exposed workers across all industries, including audiograms for 158,436 service sector workers.

They found the hearing loss within the services sector was 17 per cent, very close to that for all industries combined (16 per cent). However, many sub-sectors greatly exceeded the overall prevalence by large percentages (10 to 33 per cent higher), and many had high risk of hearing loss. Workers in solid waste combustors and incinerators had more than double the risk, the highest of any sub-sector.

Some sub-sectors were found to have higher than expected risks such as professional and technical services and schools. For example, the 'custom computer programming services' and 'elementary and secondary schools' sectors had prevalences of 35 per cent and 26 per cent respectively.

"In the services sector, additional research and surveillance are needed for sub-sectors for which there is low awareness of hearing hazards or a lack of hearing data. It is very important to identify the at-risk workers in these sub-sectors and protect their hearing, with the help of targeted interventions," said the institute.

PEROVSKITE SOLAR CELLS

ACHIEVE HIGH SOLAR CONVERSION

A team of researchers at NTU have created a perovskite solar mini module that has recorded the highest power conversion efficiency of any perovskite-based device larger than 10 cm².

Perovskites are new materials that have emerged as promising alternatives to silicon in solar cell applications. It has comparable power conversion efficiency, but the key distinguishing point is that it can be used to create light-weight, flexible, and semi-transparent solar cells ideal for applications in buildings and urban spaces.

Stability and scalability to larger sizes are seen by researchers as the last hurdles to overcome before industrial production.

Using thermal co-evaporation, a common industrial coating technique, the team found that it could fabricate solar cell modules of 21 cm² size with record power conversion efficiencies of 18.1 per cent. These are the highest recorded values reported for scalable perovskite solar cells.

Thermal evaporation is an established coating technique currently used to produce electronics including Organic Light-Emitting Diode (OLED) TVs.

Utilising the same technique, the researchers then fabricated coloured semi-transparent versions of the perovskite solar cells and mini modules, which achieved similar measures of power conversion efficiency across a whole range of different colours.

NTU Associate Vice President (Strategy & Partnerships) and Executive Director of ERI@N, Professor Subodh Mhaisalkar said the findings open doors for Singapore and urban environments in other countries to harness the power of sunlight more efficiently than ever before.

"The solar mini modules can be used on facades and windows in skyscrapers, which is not possible with current silicon solar panels as they are opaque and block light. Building owners will be able to incorporate semi-transparent coloured solar cells in the architectural designs to harvest even more solar energy without compromising the aesthetic qualities of their buildings," he said.

The NTU team is now looking at integrating perovskite and silicon solar cells to create a tandem solar cell. Development work aimed at improving its efficiency is taking place jointly with NUS' Solar Energy Research Institute of Singapore.

AIRBUS REVEALS NEW ZERO-EMISSION CONCEPT AIRCRAFT

Airbus revealed on 21 September 2020 three concepts for the world's first zero-emission commercial aircraft, which could enter service by 2035.

These concepts each represent a different approach to achieving zero-emission flight, exploring various technology pathways and aerodynamic configurations in order to support the company's ambition of leading the way in the decarbonisation of the entire aviation industry.

All of them will rely on hydrogen as a primary power source – an option which Airbus believes holds exceptional promise as a clean aviation fuel and is likely to be a solution for aerospace and many other industries to meet their climate-neutral targets.

The three concepts – all codenamed "ZEROe" – for a first climate neutral zero-emission commercial aircraft include:

1. A turbofan design (120-200 passengers) with a range of 2,000+ nautical miles (3,700+ km), capable of operating transcontinentally and powered by a modified gas-turbine engine running on hydrogen, rather than jet fuel, through combustion. The liquid hydrogen will be stored and distributed via tanks located behind the rear pressure bulkhead.
2. A turboprop design (up to 100 passengers) using a turboprop engine instead of a turbofan and also powered by hydrogen combustion in modified gas-turbine engines, which would be capable of traveling more than 1,000 nautical miles (1,852 km), making it a perfect option for short-haul trips.
3. A "blended-wing body" design (up to 200 passengers) concept in which the wings merge with the main body of the aircraft with a range similar to that of the turbofan concept. The exceptionally wide fuselage opens up multiple options for hydrogen storage and distribution, and for cabin layout.

The blended wing body concept for Airbus' ZEROe aircraft. Photo: Airbus.

Asia-Pacific Hydrogen Summit to be held virtually in late November

Organised by the Asia-Pacific Hydrogen Association and the Sustainable Energy Council (SEC), the 1st Annual Asia-Pacific Hydrogen Summit will take place virtually, from 24 to 26 November 2020.

Sponsored by Intercontinental Energy, the Asia-Pacific Hydrogen Summit is the first regional summit dedicated to the development of the hydrogen industry in Asia- Pacific.

Due to the COVID-19 situation, the summit will be in virtual format, enabling participants to access live sessions and network with industry peers wherever they are.

"Following the success of the World Hydrogen Series launch in Amsterdam during March 2020, we are delighted to partner with APAC Hydrogen Association to deliver The First annual Asia-Pacific Hydrogen Summit, full of cutting-edge insight and collaboration building, bespoke to the region", said Soizic Le Lesle Fauvelle, Conference Producer at Sustainable Energy Council.

"With the tremendous growth expected for the hydrogen industry in Asia-Pacific and the increasing adoption of hydrogen in the energy and transport sector, the establishment of a regional conference to give companies and industry professionals the opportunity to gain knowledge and to network is very timely. In addition, we are pleased to extend our co-operation with SEC to organise our first joint conference", added Edgare Kerkwijk, Board Member of the Asia-Pacific Hydrogen Association.

CREATING A SMART AS WELL AS SAFE

AND SUSTAINABLE CAMPUS

ENGIE South East Asia has signed a Memorandum of Understanding (MoU) with the National University of Singapore (NUS) to collaborate on the university's 2030 Action Plan to develop a smart, safe and sustainable campus. Both organisations will exchange knowledge and jointly work on low carbon projects, particularly those relating to infrastructure/asset modernisation, energy efficiency services, and digital solutions. They will also jointly collaborate on research and development, incubation of start-ups, industrial internship and overseas attachment opportunities.

"NUS is already home to Singapore's first newly-built net-zero energy building. We are confident that our global energy expertise, innovative solutions and deep experience in deploying energy-as-a-service solutions with several global campuses will enable us to take the university's environmental vision further and support the co-creation of a carbon-neutral campus for the benefit of future generations", said Thomas Baudlot, CEO, ENGIE South East Asia.

The forging of this MoU follows the long-term business partnership between NUS and ENGIE. Since 2004, ENGIE has been managing and maintaining the facilities of NUS' main data centre, ensuring optimal operations and efficiency.

It is now working with NUS on a 5 MWp clean energy project, which will see ENGIE install 20,000 solar panels to power NUS' Kent Ridge and Bukit Timah campuses, including University Town. Surveys are being conducted to determine the possibility of installing an additional 3 MWp solar capacity.

ENGIE and NUS are also studying the feasibility of deploying green solutions such as wind turbines coupled with efficient energy storage systems, hydrogen power systems, precinct cooling systems, digital management of electrical networks, as well as bi-facial PV modules and solar LED lamp posts.

On a broader level, both organisations will advance innovation and entrepreneurship. This will accelerate Singapore's carbon-neutral transition, through reduced energy consumption and more environment-friendly solutions, thus contributing to the nation's sustainability goals.

ENGIE South East Asia

The ENGIE Group is a global player in low-carbon energy and services. The group aims to accelerate the transition towards a carbon-neutral world, reconciling economic performance with a positive impact on people and the planet.

The group's key businesses (in the area of gas, renewable energy and services) offer competitive solutions to customers.

ENGIE South East Asia, a cluster under ENGIE Asia-Pacific, has a team of over 2,000 employees, with a presence in Singapore, Malaysia, Thailand and the Philippines, to provide tailor-made integrated solutions for customers in commercial buildings, industries, and cities.

Using advanced technologies, innovative energy and smart solutions are created, that enhance the performance of homes, businesses and communities.

SPTEL ANNOUNCES AVAILABILITY OF ITS NEW SOFTWARE DEFINED NETWORK FOR LOCAL ENTERPRISES

SPTel, a joint venture company of ST Engineering and SP Group, recently announced the availability of its new Software Defined Network (SDN) for enterprises in Singapore. Offering flexibility, scalability, resilience and 'everything-as-a-service' capabilities, the business-class digital network enables rapid response to changing and dynamic business needs, while improving total cost of ownership.

The cloud-like network offers customers, versatile, on-demand services including bandwidth and network security, while enabling edge computing and storage, as well as Internet of Things (IoT) implementation. By provisioning services on an 'as-needed' basis, end-users pay only for the bandwidth and services required, instead of over-provisioning capacity for occasional peak usage.

"SPTel is redefining the role of the modern network provider, leapfrogging traditional network vendors by leveraging the latest technologies. Our leading-edge digital solutions will shape the market with new innovative and sustainable commercial models, ultimately delivering an end-to-end network solution that drives better total cost of ownership for customers", said Titus Yong, Chief Executive Officer of SPTel.

Secure and intelligent network

In addition to services on demand, the SDN also provides proactive distributed denial-of-service (DDoS) detection and automated mitigation services. Its in-built DDoS detection provides real-time alerts so that users can subscribe to DDoS mitigation when needed. The additional just-in-time, network protection services include virtual firewall, virtual web application and virtual secure email protection. The built-in network Artificial Intelligence (AI) monitors the network, auto-reroutes traffic on detection of disruptions, and has the ability to self-heal from disruptions.

To address the need for business agility, the SDN management dashboard provides improved network visibility and control for users. By digitalising the order and provisioning process, users enjoy faster turnaround times with appointment setting and resource checking which is completed automatically. Changes, such as re-configuring bandwidth, can be completed in hours, instead of days.

Multi-access edge cloud and IoT

The SDN, coupled with SPTel's fibre pathways, ultra-low latency network and edge cloud computing abilities, will support and accelerate the digitalisation efforts of businesses in Singapore, enabling agile activation of edge cloud computing resources at SPTel's pervasive hubs for IoT deployments.

With the developing trend towards building container-based micro services for IoT solutions, container applications can be pushed seamlessly and quickly over the network to the nearest edge computing resource for rapid deployment of IoT applications. This is useful for Small and Medium Enterprises (SMEs) initiating their IoT deployments.

To-date, SPTel has partnered with several SME IoT service providers to materialise smart city initiatives such as contactless temperature sensing, smart bins and utility tracking. By working with these solution partners on a common IoT deployment platform supported by the SDN, SPTel aims to build a community of IoT solution providers to deliver a more integrated, agile and cost-effective suite of solutions.

SPTel's IoT-as-a-Service and edge cloud can be further enhanced with SDN, as additional sensors, connectivity and computing power can be provisioned quickly through the management dashboard.

"All of this can be provisioned on a utility basis, so customers can scale their IoT deployment as requirements grow, without hefty upfront investment", explained Mr Yong.

In addition to its new SDN capabilities, SPTel has integrated an SD-WAN solution with the management dashboard, that will give customers additional visibility over their network utility, and manage network traffic and configurations, even for employees working on their home networks. This will extend their secure corporate network environment to the home, removing the need for additional VPNs and improve productivity of segregated teams. Customers are provided with a one-stop management dashboard for full control over their ICT applications - a first in Singapore.

"Beyond the platform, a skilled workforce with the relevant expertise and competencies to operate the new technologies and specialised processes of the SDN is critical. We are committed to grooming our local tech talent and accelerating their professional development through programmes such as the Company-Led Training Programme (CLT) under the Infocomm Media Development Authority's TechSkills Accelerator initiative. We presently have 54 professionals undergoing training under the CLT, and are planning to train another 59 by 2021", Mr Yong said.

SPTel

SPTel uses unique fibre pathways that combine leased SP Group infrastructure and owned fibre pipes, laid alongside the power network cables.

Through this, SPTel provides a differentiated design and diverse business class digital network solution for discerning, best-in-class enterprises and mission-critical businesses.

LITHIUM-ION BATTERY REJUVENATION TECHNOLOGY SOLUTION

CREATED IN SINGAPORE

Bringing batteries back to life supports the circular economy.

Lithium-ion batteries (LIBs) are now the world's preferred source of portable energy, but the sad reality is that, with a functional lifespan of only one to three years, up to 95% of these batteries soon end up as e-waste in landfills.

Singapore generates about 60,000 t of e-waste a year. Waste disposal is a major challenge for Singapore, with the only landfill for incinerated waste, at Pulau Semakau, expected to run out of space by 2035.

In an attempt to curb this worrying trend, the Ministry of Sustainability and the Environment (MSE), formerly the Ministry of Environment and Water Resources (MEWR), and National Environment Agency (NEA) have introduced an Extended Producer Responsibility (EPR) framework for e-waste, which takes effect in just six months, starting from 2021.

The EPR deadlines mean that local electronics producers will now have to take on the responsibility for the collection and proper treatment of e-waste, but current LIB recycling options are not economically viable, resulting in a dismal 5% recycling rate.

However, two dedicated environmentalists, Leon Farrant and Dr Reza Katal, who spent over a decade perfecting a solution, have now set up Green Li-ion, a greentech startup in Singapore, with the former as CEO and the latter as CTO.

With their combined expertise in chemical and environmental engineering, the two co-founders developed a system comprising a patented multi-cathode processor and control unit, GLMC-1. The system is said to represent the world's most advanced LIB rejuvenation technology.

The technology

GLMC-1's technology is based on a co-precipitation sequence and control system which can process various types of spent (used) LIBs, while current technologies are said to enable processing of only a single type of LIB.

The co-precipitation method allows the recovery of cathode metal salts in their original form, without separation of the metal elements, speeding up the recycling process by two to three times. The metal salts obtained will then serve as the precursor for the synthesis of new cathode material which will form the basis for new LIBs, thereby closing the loop and contributing to a circular energy economy.

The technology can be applied to enhance existing LIB recycling processes to increase purity and profitability, but can also serve as a stand-alone system for recycling and cathode manufacturing.

From left, Mr Leon Farrant, CEO, and Dr Reza Katal, CTO, Green Li-ion.

ADVANTAGES OF GREEN LI-ION'S PROPRIETARY GLMC-1 TECHNOLOGY

The new technology is said to offer several advantages.

Environment-friendliness
The technology generates zero waste materials and there are no heavy metal discharges into the environment.

It helps to save approximately 5 tonnes of CO_2 emissions per tonne of precious metals or cathode materials extracted, compared to the CO_2 emissions due to mining and processing to get the same quantity of the materials.

Speed
It takes only 10 to 14 hours to process 1 tonne of LIBs into the end product - a cathode.

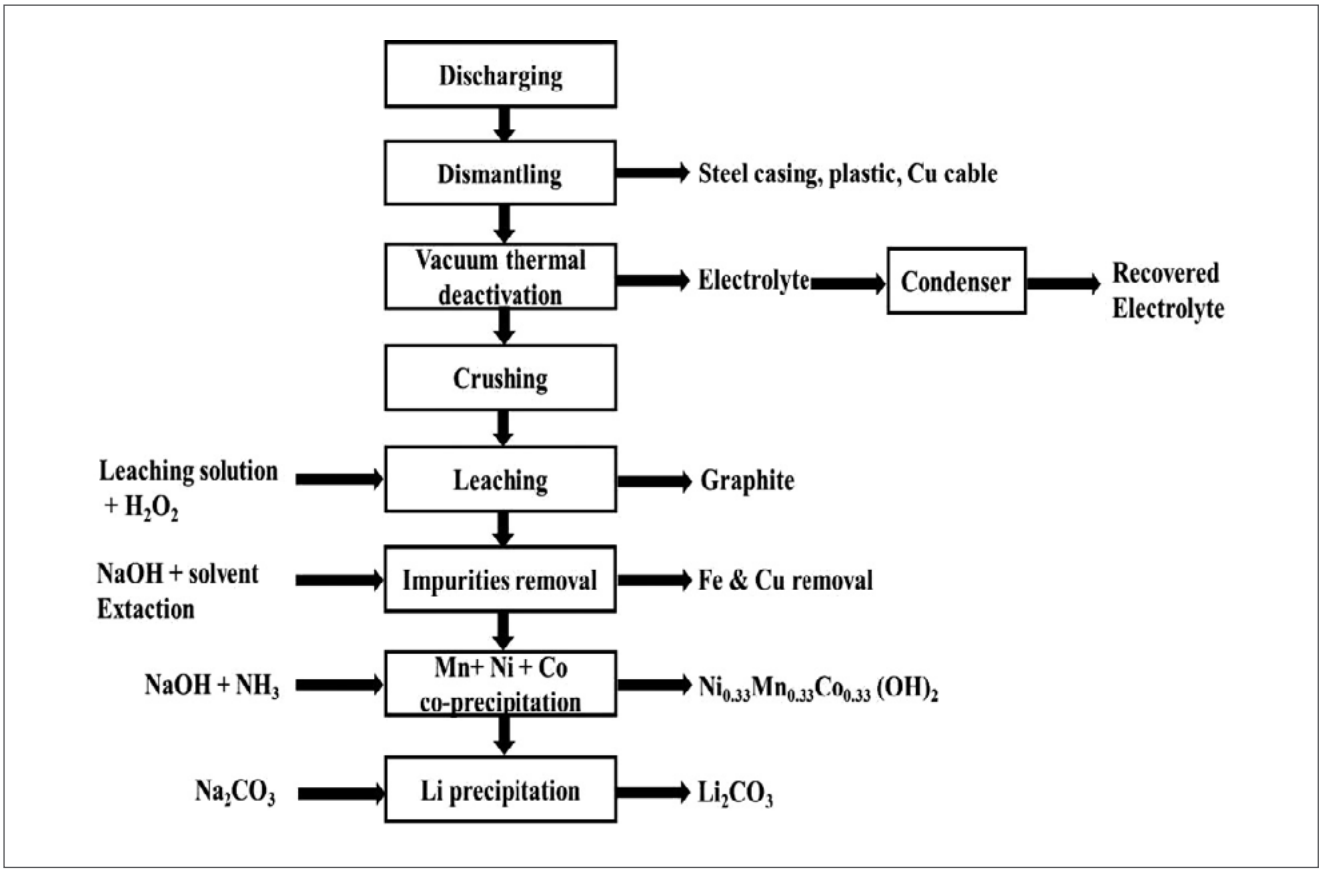
GLMC-1 simply plugs in to the end of the current recycling processes, takes in 'black mass' to separate out precious metals and re-engineers these raw materials into a usable cathode which forms part of a new functional LIB.

Higher yield
The technology enables the production of 99.9% pure cathodes.

The process recovers the following products at more than 99% purity levels:

- Graphite
- Cathode metal salts, e.g. $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$, $NiCO_3$, $MnCO_3$, CoC_2O_4, and Li_2CO_3

Increased efficiency
Green Li-ion's co-precipitation method avoids separation of the cathode metal elements, saving cost and reduces processing steps, thereby increasing recycling efficiency by over 200%.



Schematic showing the various processing stages defining Green Li-ion's LIB rejuvenation technology.

Wider range of materials handled
The technology has the ability to sort and process all major variations of LIBs such as lithium cobalt oxide (LCO), lithium manganese oxide (LMO), lithium nickel manganese cobalt oxide (NMC) and lithium nickel cobalt aluminium oxide (NCA).

Increased economic viability
Profits from LIB recycling, using this technology, are said to be four times greater than profits made using current technologies, as various types of LIBs can be processed and valuable cathode precursors can be synthesised.

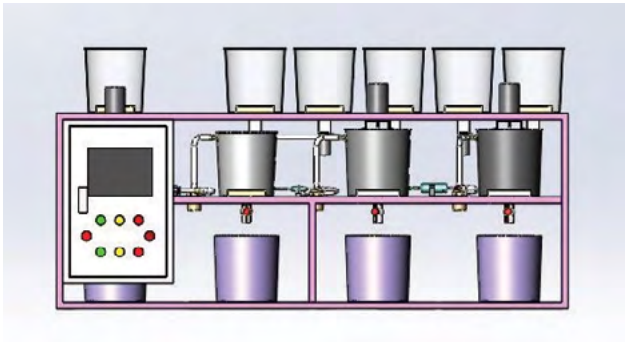
COMMERCIALISATION OF THE TECHNOLOGY

To date, Green Li-ion has raised USD 400,000 in pre-seed funding, graduating with the highest funding amount in its Entrepreneur First Singapore 2020 cohort of 10 companies, despite the global pandemic and economic downturn. One of the first investors is HAX, the US- and China-based hardware startup accelerator that is owned by SOSV.

Recently, Green Li-ion signed heads of agreement on a large seed funding round.

Professor Seeram Ramakrishna, Chair of the Circular Economy Task Force at the National University of Singapore, serves on Green Li-ion's Advisory Board.

With extensive institutional and industry support, Green Li-ion's first GLMC-1 is expected to begin operations soon and the second GLMC-1 is expected to be operational in January 2021. Green Li-ion is currently in talks with all six of Singapore's main e-waste recycling companies and major global e-recycling players in Dubai and China, to supply GLMC-1 units to their facilities. All these e-recyclers have confirmed the novelty and transformative potential of Green Li-ion's technology which is protected by four patents.



A rendering of GLMC-1, Green Li-ion's patented multi-cathode processor and control unit.

As the circular economy becomes increasingly crucial and the end-of-life legislation starts to impact battery manufacturers, the purity and efficiency of LIB recycling will be key to sustainability.

The environmental, social and economic impact of Green Li-ion's technology on the energy industry are expected to be significant.

Innovative technology receives enthusiastic reception

Mr Leon Farrant CEO, Green Li-ion, provides more information on the GLMC-1.

Question: How big is the GLMC-1 equipment? How much area does it occupy and what is its capacity?

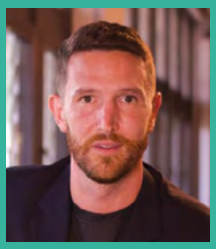
Answer: The equipment occupies 80 m². Each machine can recycle up to 728 tonnes per year or 2 tonnes per day if running on a 24-hour shift.

Q: How much energy, water and other resources are required for the GLMC-1 process?

A: There is a chemical and metals requirement for the processing of 1 tonne of lithium ion batteries, which changes according to the different battery types as the input. So this is hard to comment on. However, I can say that the water and energy consumption is not high and the carbon footprint is very low, given that it is mainly a chemical process, as opposed to a mechanical or heat induced process.

Q: Are there any effluents produced?

A: We have zero environmentally damaging discharges. The only discharge is a slightly saline water which meets NEA approvals in Singapore and most countries that we would deploy the machine in, if not all. The machine offers a closed loop solution and we use all heavy metals to reproduce an end product for sale. Any other items, plastics etc, are separated in the process and produced as a singular material item for re-sale.



Mr Leon Farrant

Q: What has been the feedback from local and overseas e-waste recyclers regarding the new technology?

A: We are humbled by the overwhelming response. We have a handful of clients who are putting in pre-orders for our machines in Singapore, Australia and the US. Most of our clients are looking at multiple machines or processing lines per facility. Our really big clients are TES in Singapore and a big client in the US.

Lithium-ion battery recycling market to grow

The lithium-ion battery recycling market is growing on account of the limited availability of lithium metal and the rising adoption of electric vehicles (EV). As a result, the industry revenue is expected to surge from USD 165.3 million in 2019 at a substantial CAGR (Compound Annual Growth Rate) of 18.3% during 2020 to 2030. In such energy storage devices, the movement of Li ions between the two terminals leads to discharging and charging, depending on the direction of the ion flow. These batteries contain less-toxic material than several others, which is why their recycling is picking up, according to a market research report published by P&S Intelligence.

The divisions of the market under segmentation by end-user are power, automotive, electrical & electronics, and others. Among these, the largest share in the industry in 2019 was held by the automotive division. Recycled material is now being used in the production of batteries, because the availability of lithium metal is limited and because the mining of lithium causes chemicals to spill into and pollute waterbodies. With the burgeoning adoption of EVs, due to the environmental degradation caused by gasoline and diesel vehicles, the demand for batteries, their primary power source and, in turn, the materials that go into them, are rising.

A key future opportunity area for market players is the growing electrical & electronics sector, as the Li-ion batteries find widespread usage in tablets, laptops, mobile phones, and several other electronic gadgets. With the expansion of this industry in South Korea, China, Thailand, and India, the demand for Li-ion batteries is rising, and can be leveraged by companies offering such recycled energy storage devices and retrieved materials.

Asia-Pacific (APAC) is the largest and fastest-growing lithium-ion battery recycling market, on account of the existence of numerous companies undertaking such tasks in the region, primarily in China. Moreover, the uptake of EVs is increasing quickly in Japan, China, Indonesia, Vietnam, and the Philippines, due to environmental concerns and strong government support. Therefore, to fulfill the demand for lithium and other components and chemicals in such batteries, they are being rapidly recycled in the region.

Thus, as the demand for electronic devices and EVs grows, so will lithium-ion battery recycling efforts.

SAVING ENERGY

IN ROLLING STOCK

by Dr Florian Magerl, Head of Technical Bid Management, Siemens Mobility GmbH; Klaus Ulreich, Technical Bid Manager, Head of Tenders, Siemens Mobility GmbH; and Dr Thomas Moshammer, Head of Structure, Simulation, Validation, Siemens Mobility GmbH

Dr Florian Magerl

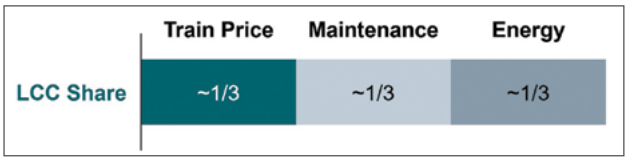
Mr Klaus Ulreich

Dr Thomas Moshammer

A leading train manufacturer discusses the work being done to achieve this objective.

INTRODUCTION

Siemens Mobility's key criteria in designing rolling stock are safety, the passenger experience, and lifecycle costs. In modern MRT systems, a train's lifecycle costs are mainly driven by the costs of maintenance and energy. Throughout the designed service life of an MRT train, the train investment costs, maintenance costs, and energy costs contribute in approximately equal parts to the overall cost.



Costs over about 30 years of a train's service life.

Leveraging the benefits of digitalisation, Siemens Mobility is at the forefront of applying innovative tools for maintenance. Railigent, the mobility application suite from Siemens Mobility Services, which runs on Mindsphere, enables rail operators to understand their rail data, generate valuable information, and get more out of their systems. Using this platform, operators can reduce lifecycle costs by extending service and maintenance intervals, and make rail transport more competitive. Using predictive maintenance helps to detect incipient failures and decreases unplanned downtime by 30% to 50%. These applications help to make 100% availability a realisitic goal.

REDUCING ENERGY COSTS

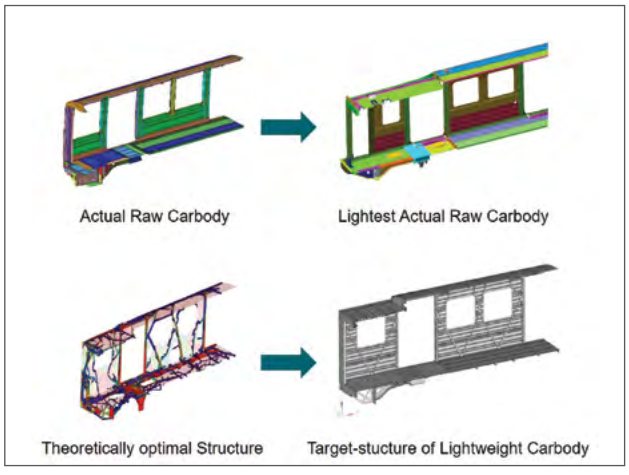
When it comes to the operator's energy costs - the other key component in lifecycle-costs - Siemens Mobility focuses on three main factors in its rolling stock design:

- Reducing vehicle weight
- Designing energy-efficient traction components
- Improving the energy balance by enabling full recuperation

Saving weight helps the operator save money. Depending on the energy costs, the monetary savings in energy costs can be SGD 50 to SGD 100 for each kilogram of mass over the car's lifecycle. The Siemens philosophy is to design a lightweight car, increase energy-efficiency and guarantee safe construction. To achieve these goals, the design and function of every component is optimised.

Weight optimised car-bodies

Optimising lifecycle costs is also the design principle for Siemens' new aluminum welded car-body concept that reduces car weight by up to 25%. The fully welded aluminum structure was optimised using FEM studies conducted by Siemens engineers. Forged parts are used, instead of welded components, with integrated functionalities, which was one of the main factors in reducing vehicle weight. It allows coupler compression loads up to 1,000 kN, which exceeds the EN12663 standard's requirements. The car body fulfills the crashworthiness requirements of EN15227.



The Siemens approach for finding the lightest suitable car-body structures.

Instead of designing CFK (carbon fibre-reinforced plastic) car-bodies, Siemens decided to use aluminum and steel, which are well-proven and well-studied materials, as the base materials for the newest trains, and accordingly optimised their application. Both materials provide the best properties for ensuring safety and high quality, that are required for products in the public transportation sector.

Trains made of CFK material are lighter in weight (the bodies are 10% to 15% lighter than a lightweight car body), but CFK in car-bodies is not as well-proven as aluminum or steel, and its durability over 30 to 35 years has not yet been verified. If a CFK vehicle has an accident, the damage is worse compared with an aluminum car body, and damage to an aluminum or steel car body is also easier to repair.

Aluminum and steel car bodies are heavier than CFK material car bodies, but they provide better endurance values and they guarantee greater safety.

Light-weight bogies

The standard passenger-coach bogie frame is a massive welded-steel construction. It carries the weight of the car body and passes the movement of the wheels to the train.

The customer expects a bogie lifetime of at least 30 years, and it must withstand various load and environmental conditions. Maintenance should be conducted at intervals up to eight years and 3 million km.

The running gear is a very important component of a rail vehicle. It is the interface between the track and the car. The bogie performs functions like track guiding, carrying the car body's weight, integrating the motor and gearbox, and integrating braking components and primary and secondary suspension.

Siemens managed to develop a new bogie frame that is 45% lighter. Instead of 1.5 t, it weighs only 900 kg. Saving that much weight on the running gear is possible thanks to innovative developments and new materials.

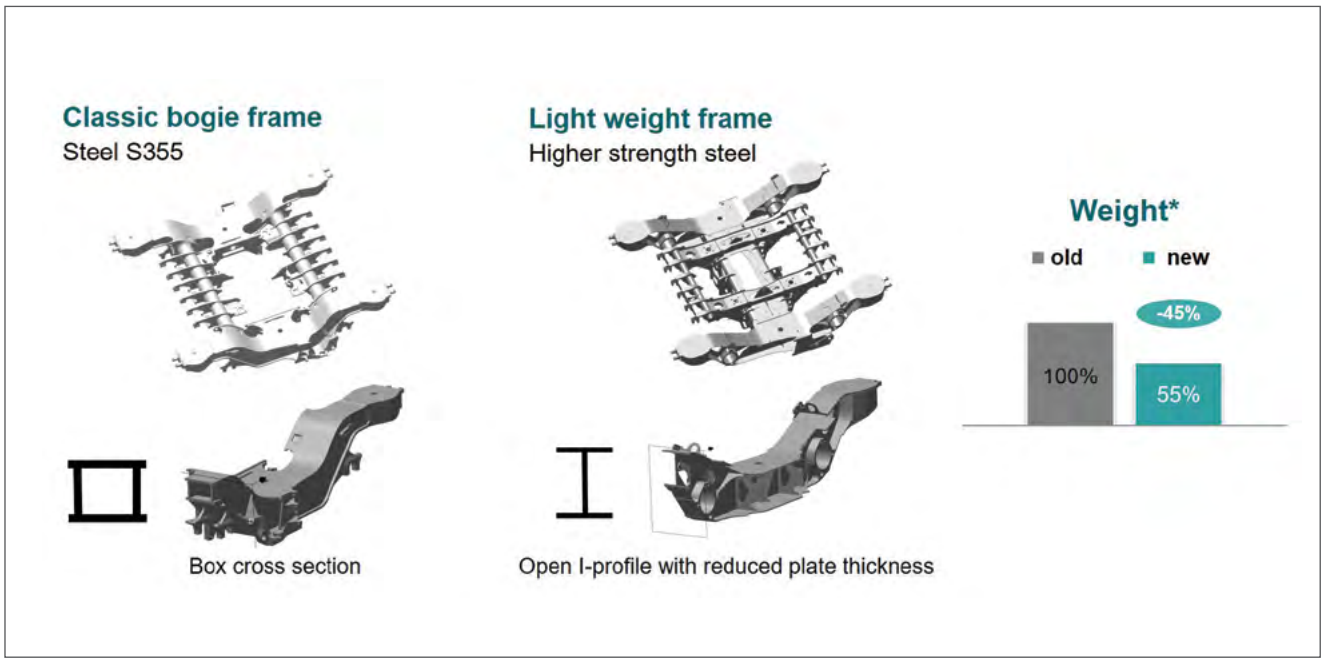
The new bogie concept applies several lightweight design and construction innovations, including:

- New bogie frame design
- The use of new materials with high stability, and use of combined materials
- Reduced wheelbase
- Compact construction
- New construction and calculation methods

Siemens worked with the Erich-Schmidt Institute at the University of Leoben in Austria, to develop fracture mechanical parameters for higher strength materials (e.g. S700). In collaboration with TU-Graz, also in Austria, Siemens tested real samples for crack growth and compared them with samples of standard steel sheet S355. At the same level of utilisation, there was no increase in crack growth speed observed, compared with S355.

Based on this new experience, Siemens built two prototypes of the bogie frame and integrated them in the running gears of an operating double-decker train. This train was successfully tested at intensive distances to check the stability in running behaviour and in vibration behaviour. This vehicle is now approved and is being used for public passenger transport.

This innovative new bogie lays the foundation for a new generation of efficient bogies for various car families and is already in serial production for metro trains as well.



Innovative new bogie-cross frame from Siemens.

Efficient traction components and electrodynamic braking

As a train manufacturer, Siemens partners with customers to supply everything, from individual components to entire trains. The company's innovative and reliable system solutions for traction converters, motors, and gears are perfectly synchronised and precisely customised for customers' requirements. Drive components are supplied for other international manufacturers as well as for Siemens trains. Railway operators can rely on the many advantages of Siemens' technology for all kinds of rolling stock. Operators benefit from the many advantages of the company's portfolio for high-speed trains, trams, metros, regional or local trains, coaches, and locomotives.

The Siemens product portfolio covers the entire control and traction system, beginning with the Siemens Train Control System (SiBAS) that provides all the signals for the combined drive and brake control unit (DBCU). These signals are tailored to customer needs, based on the track, load, acceleration, time schedule, and brake characteristics. The Siemens in-house traction converter units cover a wide range from 460 kW to 1,100 kW in two voltage classes, 750 VDC and 1,500 VDC, to power the traction motors. In conjunction with the Siemens brake system, this system allows a 100% electrodynamic braking from maximum speed down to zero, so the system can recuperate the entire braking energy back into the power network. In this case, the electropneumatic brake system is used only as an emergency brake, which helps increase the lifespan of the brake paddles and reduce the amount of brake abrasion dust in tunnel systems.

For traction motors, Siemens builds a wide range of asynchronous motors and permanent-magnet motors. Copper is used in the rotor design, which results in low losses due to the metal's superior conductivity. Lower losses translate into higher energy-efficiency and an increased power-to-weight ratio. The permanent-magnet motors are ideal for applications with very demanding efficiency requirements, because no energy is needed to set up the rotor field.

Motor and gearbox for a metro system.

Depending on customers' requirements, Siemens engineers will choose from available products, optimise an existing motor, and they can also design a completely new motor type.

Commitment to energy-efficiency

Energy-efficiency does not just benefit operators - it also minimises impacts on the environment, making public transportation even more competitive in dense urban areas. By giving a train's lifetime energy expenditure the same weight as investment and maintenance costs in evaluations, and even considering the environmental benefits of decreased energy consumption, operators can assess the actual lifecycle costs of new fleets. Therefore, it is extremely important to make energy consumption transparent, and this is the responsibility of authorities, train operators and train suppliers, alike.

Siemens Mobility has been testing its components and trains for more than 20 years in the Test and Validation Center Wildenrath (PCW) in western Germany. This is where almost all of the trains made by Siemens are inspected under realistic conditions. From high-speed trains and locomotives to commuter trains, metros, and light-rail vehicles, just about every type of rail vehicle can be inspected and certified at the PCW. The testing includes simulation of real operating conditions and the exact measurement of energy consumption before trains start running on the operator's infrastructure. These measurements allow Siemens, as train suppliers, to further optimise traction settings where necessary and, in some cases, revise the design of selected components before the train starts operations.

Today, energy consumption can be traced throughout a train's actual operation, and commitments to reduce energy consumption figures need to be kept, and incentivised if applicable. Penalties should be imposed if these commitments are broken. This gives the operator, and ultimately, society, the benefit of energy-efficient and environment-friendly trains that, in some cases, can even evolve throughout their service life, contributing even more to lifecycle cost reductions.

Rotor design.

CONSTRUCTION OF FLOATING SOLAR

PHOTOVOLTAIC SYSTEM COMMENCES

The project will enable the integration of green technology with water treatment.

PUB, Singapore's National Water Agency, and Sembcorp Floating Solar Singapore, a wholly-owned subsidiary of Sembcorp Industries (Sembcorp), have announced the commencement of construction of the 60 megawatt-peak (MWp) floating solar photovoltaic (PV) system on Tengeh Reservoir.

Sembcorp is a leading energy, marine and urban development group, operating across multiple markets worldwide.

This announcement marks a significant milestone in building one of the world's largest inland floating solar PV systems, which not only helps to reduce dependency on fossil fuels and thus carbon emissions, but also builds national climate resilience for a more sustainable future.

Solar energy is Singapore's most viable renewable energy source, but large-scale deployment of solar panels is challenging due to the country's dense urban landscape and limited land. Beyond rooftops and vertical spaces, PUB's large expanse of water bodies and reservoirs can now serve the dual purpose of water catchment and electricity generation. This follows positive trial outcomes and extensive environmental studies which show that floating solar panels have minimal impact on the reservoir's water quality and biodiversity.

The large-scale floating solar PV system at Tengeh Reservoir, the first of its kind in the region, will enable Singapore to be one of the few countries in the world to integrate green technology with water treatment. When the project begins full commercial operations next year, the amount of clean energy generated will be sufficient to power PUB's local water treatment plants, offsetting 7% of PUB's annual energy needs.

Innovative design with sustainable materials and use of smart technologies to enhance operations

The project will also incorporate new innovations in floating solar PV design and construction. Every component of the system was carefully designed and selected, based on Singapore's climate conditions, in order to maximise energy generation, minimise environmental and water quality impact, and be durable enough to fulfil a service lifespan of 25 years.

These include double-glass PV modules, instead of the single-glass variant commonly used for rooftop installations, to enhance durability in a wet and humid environment. The PV modules are supported by certified food-grade quality, high density polyethylene (HDPE) floats which are UV-resistant, to prevent degradation from the intense exposure to sunlight.

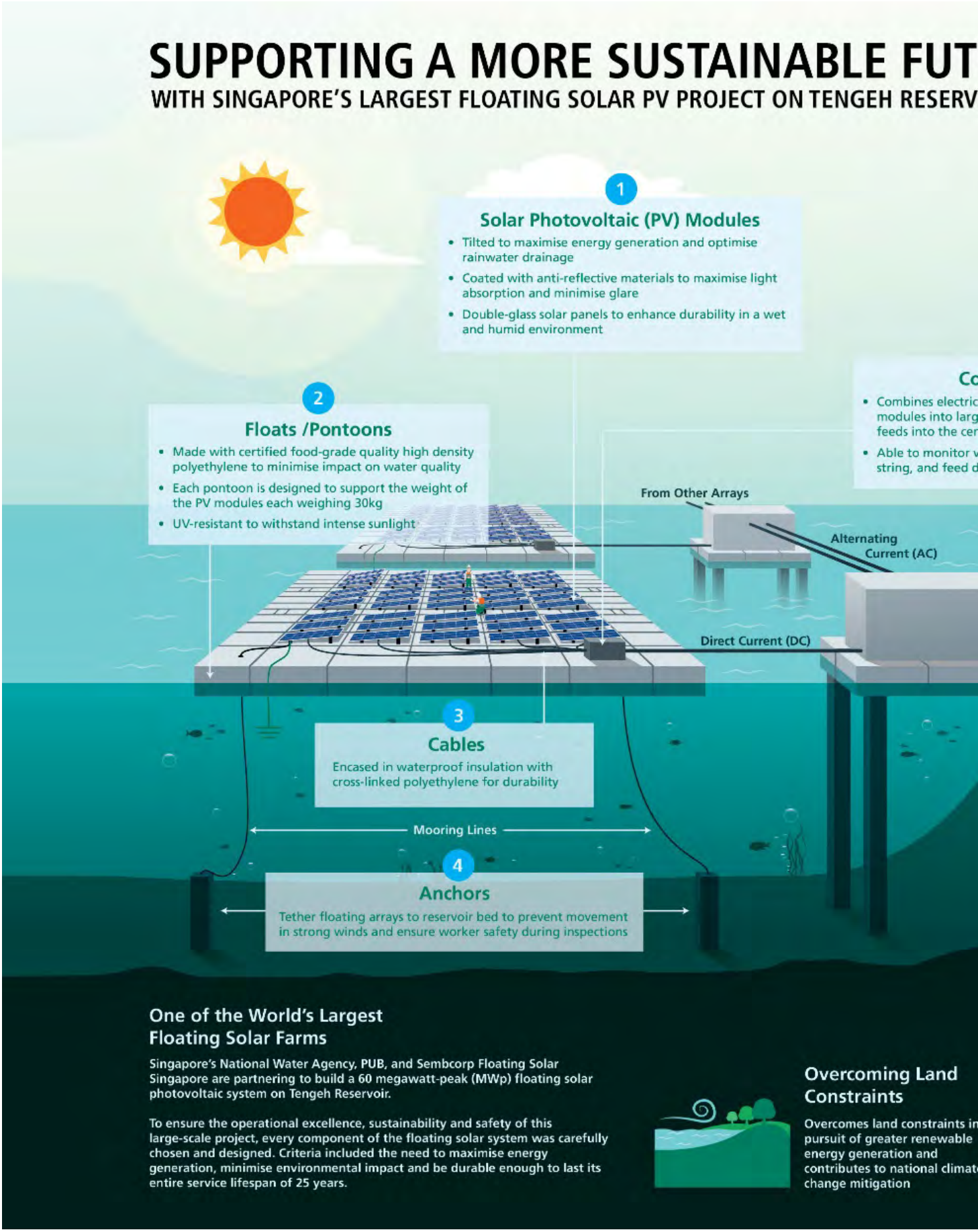
Artist's impression of the upcoming 60 MWp floating solar PV system on Tengeh Reservoir, that will occupy an area of about 45 football fields.

To optimise performance and reliability of operations, the system is backed by a digital monitoring platform which features safety cameras, 'live' video monitoring, dashboards and alerts that help to track environmental factors such as wind speed, solar irradiation and ambient temperature. The system also detects abnormalities that may indicate potential overheating and fire hazards, for preemptive troubleshooting.

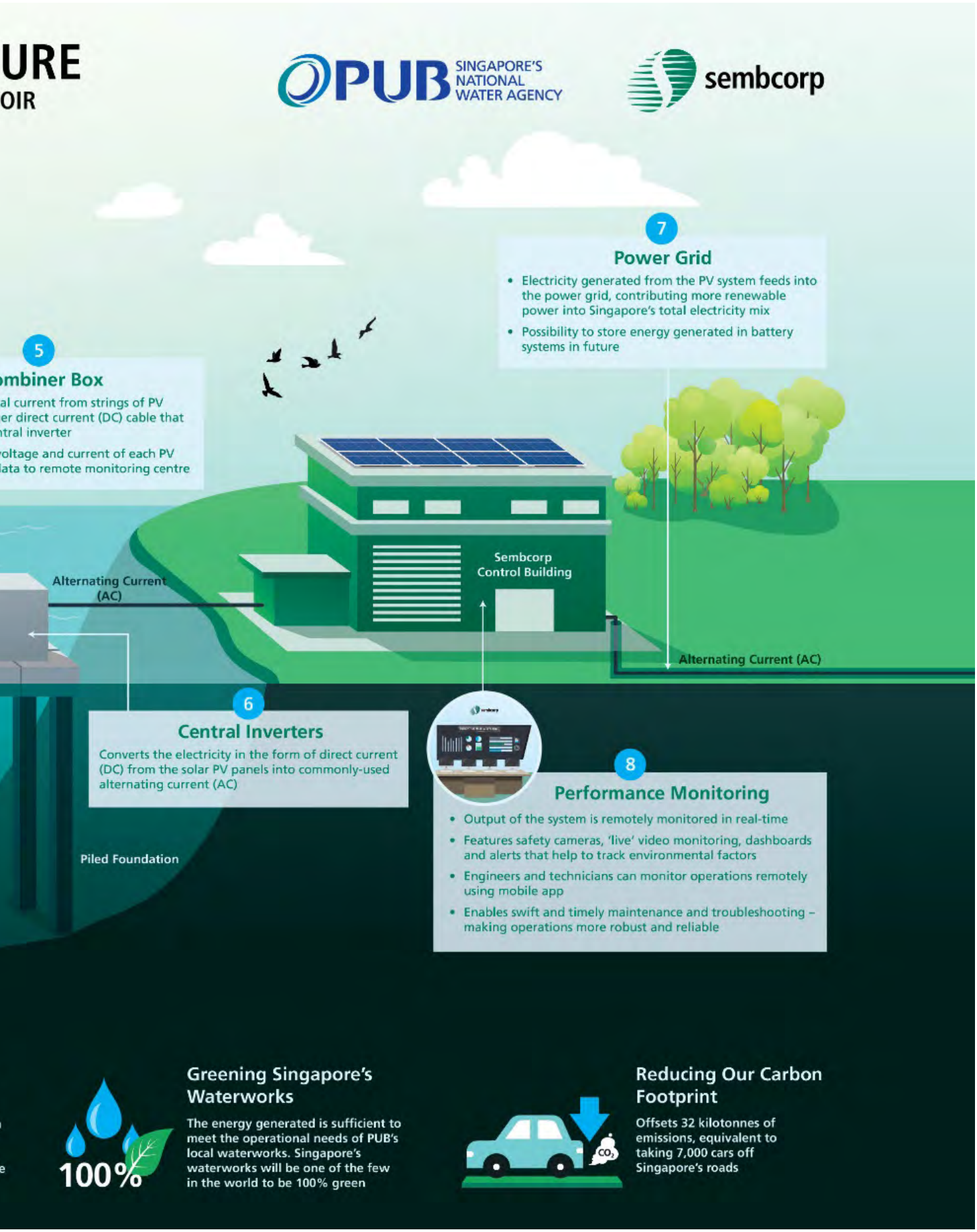
The staff will be able to monitor the system remotely via a mobile application which allows maintenance teams to be swiftly deployed when required.

"With this floating solar power plant, which we believe to be one of the largest in the world, PUB takes a big step towards enduring energy sustainability in water treatment. Solar energy is plentiful, clean and green, and is key to reducing PUB's and also Singapore's carbon footprint", said Mr Ng Joo Hee, Chief Executive, PUB.

"As Singapore's leading renewable energy player, Sembcorp is committed to helping our communities live more sustainably. This large-scale floating solar platform, which features the deployment of advanced technological and system innovations, will also enhance Singapore's global position in renewable energy production. We are excited and honoured to partner PUB on this landmark project to provide green power to our nation", said Mr Wong Kim Yin, Group President & CEO, Sembcorp Industries.



Infographic on the floating solar PV system on Tengeh Reservoir.


URE
OIR
PUB SINGAPORE'S NATIONAL WATER AGENCY
sembcorp
7
Power Grid
• Electricity generated from the PV system feeds into the power grid, contributing more renewable power into Singapore's total electricity mix
• Possibility to store energy generated in battery systems in future
5
ombiner Box
al current from strings of PV
er direct current (DC) cable that
ntral inverter
oltage and current of each PV
ata to remote monitoring centre
Sembcorp Control Building
Alternating Current (AC)
Alternating Current (AC)
6
Central Inverters
Converts the electricity in the form of direct current (DC) from the solar PV panels into commonly-used alternating current (AC)
8
Performance Monitoring
• Output of the system is remotely monitored in real-time
• Features safety cameras, 'live' video monitoring, dashboards and alerts that help to track environmental factors
• Engineers and technicians can monitor operations remotely using mobile app
• Enables swift and timely maintenance and troubleshooting – making operations more robust and reliable
Piled Foundation
100%
Greening Singapore's Waterworks
The energy generated is sufficient to meet the operational needs of PUB's local waterworks. Singapore's waterworks will be one of the few in the world to be 100% green
CO2
Reducing Our Carbon Footprint
Offsets 32 kilotonnes of emissions, equivalent to taking 7,000 cars off Singapore's roads

HEALTHCARE FACILITIES

RESPOND TO THE PANDEMIC

Heating, Ventilating, and Air-Conditioning (HVAC) systems to reflect changing space and management needs.

The COVID-19 pandemic has overwhelmed every industry and especially the healthcare sector.

According to the IBISWorld report, Australia had less than 20% of public hospitals equipped with a specialised Intensive Care Unit (ICU) required for looking after the most critically ill patients.

NHS England confirmed that up to 20% of affected patients in several hospitals caught the coronavirus within the premises of these facilities, while they were being treated for other diseases.

This made people become more aware of not only airborne respiratory illnesess but also the role of hospitals.

The pandemic outbreak has posed a significant challenge for healthcare facilities, and life in the post-pandemic world is not going to be the same as before.

Changes are taking place in the spatial and management aspects of healthcare facilities to prepare them for the 'new normal' after the pandemic.

Spatial reconfiguration

Increasing adoption of telehealth will accelerate change in space use. According to a survey conducted by McKinsey, adoption of telehealth in the US skyrocketed from 11% in 2019 to 46% during the pandemic. Updox, a virtual care communication company, found that out of 2,000 US adults, 51% would continue using telehealth services even after the pandemic.

Another spatial change to be made is the expansion of negative pressure rooms. Building these rooms is one way in which healthcare facilities are transforming themselves into a pandemic-ready area. A negative pressure room can keep the inside-air pressure lower than the surrounding environment to isolate viruses and reduce the risk of infection.

Hospital General de Latacunga in Ecuador, for example, has a negative pressure room, equipped with solutions from LG Electronics, which allow effective zone pressure control. Multi V, LG's Variable Refrigerant Flow (VRF) system is connected with an Air Handling Unit (AHU) which is fitted with a high-efficiency particulate air (HEPA) filter. The filter removes 99.97% of all airborne particles down to 0.3 µm in size with MERV (Minimum Efficiency Reporting Value) 17, conforming to global standards. This combination re-conditions and circulates air, maintaining a stringently hygienic environment.

Indoor air purification panel installed on ceiling

LG Air Purification Technology.

Changes in management

There also needs to be a transformation in the management. Indoor Air Quality (IAQ), which has always been a priority for healthcare facilities, has become even more important than before the pandemic.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has stated that changes to building operations, including the operation of HVAC systems, can reduce the exposure to airborne viruses.

That is why hospital air-conditioning plays a greater role than just promoting comfort. The effective HVAC solution not only provides a comfortable temperature and humidity, it also collects pollutants and draws pure air through the filtering element.

LG's Multi V indoor units is a good example. They are equipped with a four-step air purification filter which removes up to 99.9% PM 1.0 ultrafine dust, ensuring high indoor air quality.

Improving cost-efficiency is another challenge that healthcare facilities are facing in managing buildings, as they are going through unprecedented financial fallout caused by the pandemic.

The American Hospital Association estimated the financial loss caused within a four-month period, from March to June this year, to be USD 202.6 billion.

To cut down costs in the operation of healthcare facilities, maximising energy efficiency is key because, unlike other commercial buildings, they operate 24 hours a day, 365 days a year.

According to the US Department of Energy, the energy use intensity of healthcare facilities is 2.5 times greater than that for commercial office buildings.

The application of innovative technology has enabled LG Electronics to offer energy-efficient air-conditioning systems. The company says that its LG Multi V 5, which is its latest VRF system, has an inverter compressor that increases the cooling efficiency by 3% and the heating efficiency by 10%, compared to conventional models. A smart feature that enables the sensing of human presence to turn the air-conditioner on, and to turn it off if there is no-one in the cooled space, also contributes to optimum energy use.

LG develops a wearable air purifier

LG Electronics has developed a new category of wearable air purifier technology to deliver portable protection. The LG PuriCare Wearable Air Purifier will be available starting in the fourth quarter of this year, in select markets.

The LG PuriCare Wearable Air Purifier resolves the issues relating to inconsistent quality and shortages in the supply of masks. The PuriCare Wearable Air Purifier employs two H13 HEPA filters, similar to the filters used in the company's home air purifier products.

Employing LG's latest advancements in air purification, high-performance replaceable filters enables PuriCare Wearable to supply fresh, clean air indoors and outdoors. With its dual fans and patented respiratory sensor, LG's wearable air purifier allows users to take in clean, filtered air while the respiratory sensor detects the cycle and volume of the wearer's breath and adjusts the dual three-speed fans accordingly. The fans automatically speed up to assist air intake and slow down to reduce resistance when exhaling, to make breathing effortless.

Ergonomically designed, based on extensive facial shape analysis, LG PuriCare Wearable fits snugly on the user's face to minimise air leakage around the nose and chin. The design also makes it possible to wear the unit comfortably for hours on end. The

The LG PuriCare Wearable Air Purifier.

efficient and lightweight 820 mAh battery offers up to eight hours of operation in low mode and two hours on high (based on product usage at a temperature of 25° C).

In addition, LG's personal air solution comes with a case that helps maintain hygiene between uses. Equipped with UV-LED lights that kills harmful germs, the case can even charge the mask and send a notification to the LG ThinQ mobile app (Android/iOS) when the filters need to be replaced for peak performance. And because every component of LG PuriCare Wearable, from the filters to the ear straps, is replaceable and recyclable, it is an environment-friendly solution as well.

THE BUSINESS IMPACT OF TEST EQUIPMENT ISSUES

by Lawrence Liu, General Manager for Asia Pacific, Keysight Technologies

Mr Lawrence Liu

The resulting delays mean a loss of revenue.

Testing is a crucial element in the development cycle of any product, solution or service. No matter what sector a business operates in, it will be subject to specific frameworks, standards and regulations governing testing, to assure that its products operate effectively and safely.

But the demands placed on R&D engineers have proliferated in recent years, as the landscape becomes more complex, with increased time pressures to bring new products and services to market. There are growing incidences of workflow issues related to the use of test equipment, because the equipment has been misconfigured, or test engineers lack the necessary training or knowledge, or environmental interoperability or equipment failures cannot be debugged and resolved quickly enough. These materially add to the intensity of development cycles.

A survey was conducted by Dimensional Research, involving 305 R&D engineers from a range of global organisations, including those in the technology and telecoms sectors. The results were clear - more than 90% of companies had experienced a revenue loss because of preventable delays related to test and measurement equipment. For more than half (53% of companies), the delay in resolving technical support issues resulted in a loss of more than USD 100,000 per day.

Loss of time means loss of money. So how did this situation arise, and what can be done about it?

Test cases increase by orders of magnitude

To remain competitive, companies must eliminate obstacles that cause delays. Design complexity, frequent design changes and unfamiliar new technologies with rapidly developing standards, can force engineers to troubleshoot technical issues on the fly. Product or service development schedules do not account for time required to troubleshoot and debug such issues. To maintain aggressive schedules, they must do so without the right resources, training or expertise.

In the past, engineers would develop a deep familiarity with test equipment design and test standards. Today, they simply do not have the time to research how their test equipment works, how to optimise a configuration, or how to troubleshoot a complex setup to achieve the results required by specifications and industry standards. And with constant pressure to shorten new product development lifecycles, market-leading companies cannot afford to wait days to access technical support experts for resolution of issues.

As a practical example, in the past, R&D engineers would routinely download technical manuals to learn the inner workings of a product. They had an intimate understanding of the operation, test configuration and use cases.

Today, test matrices have spiralled vastly, increasing test cases, both in numbers and complexity. It is no longer feasible to master those cases, while meeting customer expectations and time-to-market goals. R&D engineers rely on automation and sophisticated software to achieve speed. But if a test case fails, troubleshooting can be difficult and time-consuming.

Escalating business issues

In Keysight's third-party commissioned survey, 91% of respondents said they experience business-impacting issues related to calibration, technical problem resolution or equipment performance. In addition, 46% reported their businesses suffer within the first day, with test equipment not functioning to expectations. Further, 72% said calibration issues affect their businesses within three days, and an average of 65% said that the time it takes to calibrate and repair equipment is not fast enough, or predictable, and there is a lack of the needed Service Level Agreements (SLAs) to help mitigate schedule slips.

A summary of the responses is presented as follows:

- 97% of respondents had experienced problems with test equipment, which resulted in project delays.
- 63% of respondents said they had experienced test equipment failure, which then required repair.
- 56% said they had experienced problems due to test equipment being improperly set up - problems with configuration, cabling and so on.
- 50% had experienced equipment that had not been calibrated.
- 46% had experienced problems with improper tool use, resulting from employees making mistakes, a lack of training, programming issues and so on.
- 29% had experienced delays as a result of waiting for new test equipment to be set up.

Overall cost to a company when the engineering team cannot work for just one day because of equipment problems.

Direct impact on the business bottom line

All these problems can have critical business impacts. If the R&D engineering team cannot work for just one day because of problems with test and measurement equipment, the cost can be severe. According to 53% of survey respondents, the cost of this was USD 100,000 a day or more, and 5% said it was more than USD 1 million.

In addition, 91% of respondents explained that such issues had tangible and material business impacts, from reducing product yield (cited by 53%), to products being rejected by buyers (47%), to increased product returns (45%) and even product recall (28%). Such occurrences are costly. And those costs can linger for multiple quarters as firms struggle to regain their customers' confidence and their own reputation as a quality supplier.

A material difference

In this complex environment, it is not surprising that 60% of reported problems relate to incorrect test equipment setup or improper use. These factors alone suggest that as product designs and test solutions increase in complexity, access to technical support expert resources and information becomes more important. When problems arise, companies need fast, reliable guidance to troubleshoot and resolve issues. Having the right technical support can reduce time to resolution when troubleshooting and diagnosing advanced measurement techniques.

It is interesting to note how often test professionals require assistance:

- 95% said they need help every month.
- 59% said they experience six or more technical support issues each month.
- 94% of electronic test professionals said they need committed, fast-response technical support.

What is even more apparent is that expectations and demands on technical support have dramatically changed. Nearly half the professionals surveyed said existing technical support models do not meet their expectations and business needs. They said technical support models need to be highly knowledgeable and immediately accessible with faster, committed response times, while 68% of the respondents are of the opinion that they could save multiple days each year using a priority support model.

Summary

Modern testing and development requires a modern technical support approach, tailored to meet the needs of agile, connected design and testing. Each generation of technology increases this complexity. Test and measurement companies must respond and resolve technical support issues faster to help their customers stay ahead of test standards, test methodology and equipment maintenance. Overall, priority access to test experts with committed response times and proactive notifications, calibration services as well as repair facilities with committed turnaround times and a state-of-the-art digital experience, can make a material difference, whether engineers are designing or manufacturing a product. The right support can enable a team to deliver a quality product on schedule and help avoid design or production issues that result in costly delays.

New head of Keysight's Electronic Industrial Solutions Group

Keysight Technologies Inc recently announced that Ms Ee Huei Sin, head of Keysight's General Electronics Measurement business, has been promoted to lead the Electronic Industrial Solutions Group.

Ms Ee takes over from Mr Gooi Soon Chai who has led the business since 2015. Going forward, Ms Ee will continue to lead Eggplant, the test automation software company Keysight acquired in June 2020, as well as Keysight's Order Fulfillment and Information Technology groups - all of which are key strategic functions for the company.

Ms Ee joined the company in 1992 and has held a variety of global positions, including functional and business roles. In particular, she has expertise managing general purpose electronics measurement and semiconductor industry businesses. For the last two years, Huei Sin has also led Keysight's company-wide efforts in the education market. Ms Ee is based in Penang, Malaysia and has previously worked for the company in the US.

Ms Ee Huei Sin

NEUROMORPHIC COMPUTING

TO ENABLE ROBOTS TO 'FEEL'

Work done by NUS researchers highlights the potential for improved capabilities.

Two researchers from the National University of Singapore (NUS), who are members of the Intel Neuromorphic Research Community (INRC), recently presented new findings demonstrating the promise of event-based vision and touch sensing, in combination with Intel's neuromorphic processing, in robotics. The work highlights how bringing a sense of touch to robotics can significantly improve capabilities and functionality compared to today's visual-only systems and how neuromorphic processors can outperform traditional architectures in processing such sensory data.

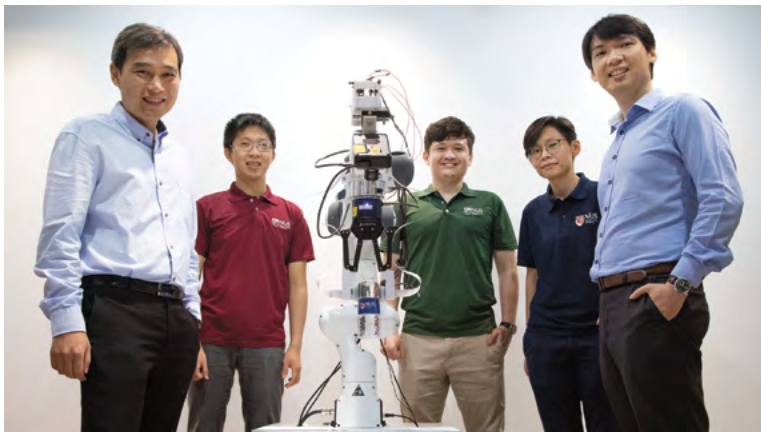
"This research from National University of Singapore provides a compelling glimpse into the future of robotics where information is both sensed and processed in an event-driven manner, combining multiple modalities. The work adds to a growing body of results showing that neuromorphic computing can deliver significant gains in latency and power consumption, once the entire system is re-engineered in an event-based paradigm spanning sensors, data formats, algorithms, and hardware architecture", said Mike Davies, Director of Intel's Neuromorphic Computing Lab.

Why it matters

The human sense of touch is sensitive enough to feel the difference between surfaces that differ by just a single layer of molecules, yet most of today's robots operate solely on visual processing. Researchers at NUS hope to change this, using their recently developed artificial skin which, according to their research, can detect touch more than 1,000 times faster than the human sensory nervous system and identify the shape, texture and hardness of objects 10 times faster than the blink of an eye.

Enabling a human-like sense of touch in robotics could significantly improve current functionality and even lead to new use cases. For example, robotic arms fitted with artificial skin could easily adapt to changes in goods manufactured in a factory, using tactile sensing to identify and grip unfamiliar objects with the right amount of pressure to prevent slipping. The ability to feel and better perceive surroundings could also allow for closer and safer human-robotic interaction, such as in caregiving professions, or bring the automation of surgical tasks closer to reality, by giving surgical robots the sense of touch that they lack today.

While the creation of artificial skin is one step in bringing this vision to life, it also requires a chip that can draw accurate conclusions based on the skin's sensory data



The NUS research team behind the novel robotic system integrated with event-driven artificial skin and vision sensors was led by Assistant Professor Harold Soh (left) and Assistant Professor Benjamin Tee (right). With them are team members Mr Sng Weicong (second from left), Mr Tasbolat Taunyazov (centre) and Dr See Hian Hian (second from right). Image: National University of Singapore.

The novel robotic system developed by NUS researchers comprises an artificial brain system that mimics biological neural networks and which can be run on a power-efficient neuromorphic processor such as Intel's Loihi chip, and is integrated with artificial skin and vision sensors. Image: National University of Singapore.

in real-time, while operating at a power level efficient enough to be deployed directly inside the robot.

"Making an ultra-fast artificial skin sensor solves about half the puzzle of making robots smarter. They also need an artificial brain that can ultimately achieve perception and learning as another critical piece in the puzzle. Our unique demonstration of an AI skin system with neuromorphic chips such as the Intel Loihi provides a major step forward towards power-efficiency and scalability", said Assistant Professor Benjamin Tee

from the NUS Department of Materials Science and Engineering and NUS Institute for Health Innovation & Technology.

About the research

To break new ground in robotic perception, the NUS team began exploring the potential of neuromorphic technology to process sensory data from the artificial skin, using Intel's Loihi neuromorphic research chip. In their initial experiment, the researchers used a robotic hand fitted with the artificial skin to read Braille, passing the tactile data to Loihi through the cloud to convert the micro bumps felt by the hand into a semantic meaning. Loihi achieved over 92% accuracy in classifying the Braille letters, while using 20 times less power than a standard Von Neumann processor.

Building on this work, the NUS team further improved robotic perception capabilities by combining both vision and touch data in a spiking neural network. To do so, they tasked a robot to classify various opaque containers holding differing amounts of liquid using sensory inputs from the artificial skin and an event-based camera. Researchers used the same tactile and vision sensors to test the ability of the perception system to identify rotational slip, which is important for stable grasping.

Once this sensory data was captured, the team sent it to both a GPU and Intel's Loihi neuromorphic research chip to compare processing capabilities. The results, which were presented at 'Robotics: Science and Systems', show that combining event-based vision and touch using a spiking neural network enabled 10% greater accuracy in object classification compared to a vision-only system.

Moreover, they demonstrated the promise for neuromorphic technology to power such robotic devices, with Loihi processing the sensory data 21% faster than a top-performing GPU, while using 45 times less power.

"We are excited by these results. They show that a neuromorphic system is a promising piece of the puzzle for combining multiple sensors to improve robot perception. It is a step toward building power-efficient and trustworthy robots that can respond quickly and appropriately in unexpected situations", said Assistant Professor Harold Soh from the Department of Computer Science at the NUS School of Computing.

The Intel Neuromorphic Research Community

The Intel Neuromorphic Research Community is an ecosystem of academic groups, government labs, research institutions, and companies around the world, working with Intel to further neuromorphic computing and develop innovative AI applications.

Intel

Intel is an industry leader, creating technology that enables global progress and enriches lives. Inspired by Moore's Law, Intel works to advance the design and manufacturing of semiconductors to help address customers' greatest challenges. By embedding intelligence in the cloud, network, edge and every kind of computing device, Intel maximises the potential of data to transform business and society for the better.

Intel Xeon scalable platform built for sensitive workloads

Intel recently unveiled a suite of new security features for the upcoming 3rd generation Intel Xeon Scalable platform, code-named 'Ice Lake'.

Intel is doubling down on its Security First Pledge, bringing its pioneering and proven Intel Software Guard Extension (Intel SGX) to the full spectrum of Ice Lake platforms, along with new features that include Intel Total Memory Encryption (Intel TME), Intel Platform Firmware Resilience (Intel PFR) and new cryptographic accelerators to strengthen the platform and improve the overall confidentiality and integrity of data.

Data is a critical asset both in terms of the business value it may yield and the personal information that must be protected, so cybersecurity is a top concern. The security features in Ice Lake enable Intel's customers to develop solutions that help improve their security posture and reduce risks related to privacy and compliance, such as in regulated data in financial services and healthcare.

"Protecting data is essential to extracting value from it, and with the capabilities in the upcoming 3rd Gen Xeon Scalable platform, we will help our customers solve their toughest data challenges while improving data confidentiality and integrity. This extends our long history of partnering across the ecosystem to drive security innovations", said Lisa Spelman, Intel Corporate Vice President in the Data Platform Group and General Manager of the Xeon and Memory Group.

Data protection across the compute stack

Technologies such as disk- and network-traffic-encryption protect data in storage and during transmission, but data can be vulnerable to interception and tampering while in use in memory. 'Confidential computing' is a rapidly emerging usage category that protects data while it is in use in a Trusted Execution Environment (TEE). According to Intel, the Intel SGX is the most researched, updated and battle-tested TEE for data centre confidential computing, with the smallest attack surface within the system. It enables application isolation in private memory regions, called enclaves, to help protect up to 1 terabyte of code and data while in use.

RUGGED SOLUTIONS TO DRIVE THE MANUFACTURING INDUSTRY

by Rick Hwang, President of Rugged & Video Solutions Business Group, Getac Technology Corporation

Mr Rick Hwang

Mobile devices, specially designed for harsh manufacturing environments, can effectively help companies embrace Industry 4.0.

INTRODUCTION

The manufacturing industry is undoubtedly a core pillar of economic growth in Singapore, accounting for a fifth of the economy and employing more than 400,000 workers, or approximately 14% of the labour force.

And it will continue to be a key pillar for economic growth. But factories in Singapore are finding themselves increasingly under pressure. Mounting regional competition, rising business costs and a tightening labour market are all factors that Singapore's manufacturers find themselves grappling with.

The good news is that the government is already working towards addressing these issues through industrial transformation. Several incentives and grants to help businesses automate their existing processes and support their digital transformation have been put in place to ensure the country maintains its position as a globally competitive manufacturing hub.

According to the Singapore Economic Development Board (EDB), Singapore's manufacturing base has been "gearing up to adopt the Industry 4.0 model to enable digitalisation and automation of its processes, enhancing its efficiency and long-term competitiveness on the global stage. This new-age approach allows for high-level integration of information, communication and systems by connecting multiple devices and machines at every step of the manufacturing process".

As external pressures mount and as the COVID-19 global pandemic places greater strain on the industry, it is time for businesses to embrace innovation such as intelligent warehouse management systems, predictive maintenance, robotics, and artificial intelligence (AI).

REINVENTION OF MANUFACTURING OPERATIONS

Manufacturers looking to make the switch to Industry 4.0 will need to recognise that adopting the right technologies will play a critical role in enabling their transformation journey. In recent years, as integrated technology has become the norm in manufacturing plants for driving assembly operations, forklift transportation, quality control, and management oversight, the acquisition of tools that can control everything from any location has shifted from the 'nice-to-have' to the 'must-have' category.

The introduction of mobile devices has enabled such scenarios and enhanced workflows within factories. But not all mobile devices are created equal. Due to the dynamic nature of the manufacturing industry, companies require mobile devices that perform even in harsh environments and are portable. That is where rugged tablets and laptops, which are designed to function in the manufacturing industry, would come in handy.

Rugged industrial-grade mobile devices

Industrial tablets and laptops are becoming increasingly popular in the manufacturing industry. Manufacturing companies choose to deploy rugged tablets and laptops due to their durability, reliability, and relatively low total cost of ownership.

For starters, quality control is a crucial element of manufacturing. Rugged laptops, such as Getac's B360, come with the capability of including applications and extensions that help track and monitor production operations, to ensure that products meet the quality standards required.

Rugged laptops are specially made to be lightweight and compact so that workers may carry them with ease or store them in small compartments when necessary.

When the work environment requires the worker to wear gloves at all times, the rugged laptop can be easily operated, since the LumiBond 2.0 Technology touchscreen display feature responds seamlessly to a diverse range of touch activation. This provides the worker with the ability to navigate through the device while working on any task, without having to remove the gloves.

Additionally, in such fast-paced, high-powered industries, cumbersome equipment can put workers under undue strain. Rugged laptops are specially made to be lightweight and compact, so that workers may carry them with ease or store them in small compartments when necessary.

Rugged laptops possess incredible toughness, which is particularly beneficial for manufacturing companies. Factories are often challenging operating environments for tablets. Devices must be able to handle extreme vibrations, volatile temperatures, and even large amounts of dust. Unlike consumer-grade laptops, rugged laptops are engineered to survive in such harsh conditions. Not only are they built to weather dust and water, they are also built to survive vibrations, shocks, and drops from heights of up to 6 ft.

While protective cases may shield the exterior of consumer laptops, they do not possess the same level of performance compared to rugged laptops. Prolonged periods of operation in such harsh conditions would severely damage the internal drive of consumer laptops. Deploying rugged laptops minimises disruptions caused by having to replace faulty equipment regularly.

Furthermore, introducing rugged tablets into the manufacturing process can potentially reduce workloads for staff, and value adds to several functions. They can transform the tedious process of collecting data.

When equipped with rugged laptops, workers in the manufacturing sector no longer have to manually document product information, which would typically lead to readability issues or even paperwork being lost, thereby decreasing productivity.

Equipped with rugged laptops and the powerful processors of these devices, workers can more easily collect, process, and transfer data and information quickly, thereby eliminating manual data entry entirely.

Equipped with rugged laptops and the powerful processors of these devices, workers can more easily collect, process, and transfer data and information quickly, thereby eliminating manual data entry entirely.

Moreover, the data collected is always accessible. With that said, having the ability to sync data in real-time across departments removes human errors from the equation, leading to better quality control and minimised downtime. Furthermore, when data is accessible in a digital form, data sets can be used to generate insights that can control the quantity and quality of goods produced.

Rugged laptops also ensure crisp readability even under glaring sunlight and when night falls - which is an essential feature when work needs to be done round-the-clock.

Connectivity and security

Connectivity is vital for manufacturing operations. For instance, Getac's B360 rugged laptop provides Wi-Fi, 4G LTE and GPS connectivity, allowing workers in the manufacturing sector to stay connected at all times, transferring and receiving data regardless of where they are. Also, the whereabouts of workers and visitors can be easily tracked and located, helping operators to follow safety regulations and minimise accidents.

With the manufacturing industry being frequently targeted by hackers, it is essential that any connected device introduced has robust security baked in. Today's rugged laptop comes with multi-factor authentication capabilities, including an RFID reader, smart card reader and face-authentication. Advanced authentication enables unique user account management and data access authorisation. Paired with data encryption and secure data transmission, rugged laptops can protect confidential data all the way to end-points.

Continuity of power supply

Thanks to high-capacity hot-swappable batteries, rugged laptops allow for secure battery replacement without the need for the device to be turned off. This enables users to continue functioning round-the-clock, without being concerned about downtimes. This again improves productivity.

SUMMARY

Manufacturing is at the core of a robust economy. A manufacturer's business operations will be seamless if rugged solutions are introduced. Hence, with highly digitalised functions, such as cloud integration, a multi-factor authentications system and interconnectivity, rugged solutions will be key for the growth of not only manufacturing businesses but also the nation's economy.

FROM FAILURE ANALYSIS TO GEARBOX RE-DESIGN

by Robert Shandro, Principal Consultant, Cetim-Matcor

Robert Shandro

A logical failure analysis approach is more than just a diagnosis. It is an appropriate method of observation and analysis, based on specific knowledge and extensive experience, that leverages a global vision of the failure to provide advice for improvement and redesign.

Oceanic Phoenix. Image: Wikimedia Commons/Halley Pacheco de Oliveira.

Oceanic Phoenix, owned by CGGVeritas, is an offshore scientific research vessel used for the acquisition of seismic data from the seabed.

The vessel faced a significant problem a few years ago. The tapered roller bearings of the gearboxes in the power transmission system were subjected to an alarming level of vibrations - 20 mm/s RMS instead of the recommended 7 mm/s. These vibrations caused the failure of the bearings.

The propulsion system is composed of two shaft lines and a variable pitch propeller. Each shaft is driven by two 2 MW electric motors via a gearbox that reduces the rotation speed of the motors from 900 RPM to 130 RPM. This redundancy in the architecture was expected to allow the vessel to operate in a degraded mode, in the event of a failure of one of the two systems. Despite this, defects occurred in both gearboxes.

No shutdown during onsite operation

Two on-board missions conducted during technical downtime of the vessel helped to identify the cause of the failure. The teeth extremities of the input pinions were damaged (in the tooth root region) by micropitting and pitting. The maximum density of the surface degradation corresponded to the area with maximum intensity of the surface contact pressure (the localised tooth contact pattern). Also, one tooth of the input pinion was found to be broken at the extremity. A large part of the tooth was detached due to crack propagation along the case/core transition area.

Broken tooth of input pinion. The cracking was initiated under the case hardened layer and it then propagated parallel with the tooth flank.

Spalling on the running path pattern of the outer ring of the tapered roller bearing.

Also, the middle shaft's tapered roller bearings were more damaged than the other bearings. Significant spalling was observed on the outer rings of the bearing, specifically localised at the loaded area. The input shaft bearings had a running path pattern, varying in width on

two diametrically opposed areas. These point to an outer ring misaligned in the housing or a shaft misalignment.

Detailed modelling of gearbox

Examinations performed on-board allowed Cetim-Matcor to conclude that observed damage on gear wheels and on bearings were due to:

- Gearbox rigidity
- Shaft deflection and misalignment
- Bearing selection and mounting
- Microgeometry of gears (tooth flank modifications)

Based on the results of on-site examinations, it was decided to create a detailed model of the housing, shafts and bearings (by using their detailed internal geometry) as well as gears (focusing on the gear microgeometry). The main objective of the global calculation was to acquire a further understanding of the operating conditions.

The calculations (according to the standards ISO 6336, ISO/TS 16281 and DIN 743), confirmed the assumptions drawn from the examinations and measurements. In fact, the housing deformation and inaccurate tooth flank modifications were responsible for excessive vibrations, failure of the bearings and premature teeth rupture.

With regard to the teeth, it was found that these deformations caused misalignment which led to an excessive load applied to the extremity of the teeth, resulting in their premature damage.

The solution

Two solutions are generally possible - reconstructing the shaft line or solidifying the housing. The first solution is extremely expensive and the second would put the vessel out of operation for an excessively long time.

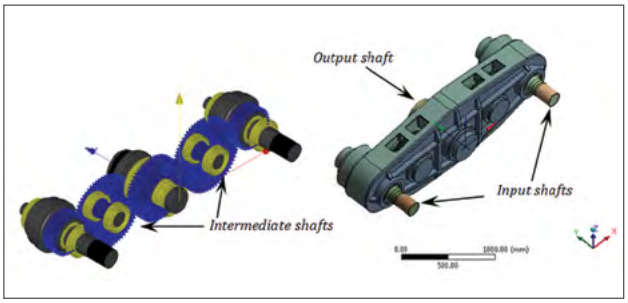
The alternative from Cetim-Matcor, which was implemented, involved adapting the teeth microgeometry to the housing deformation. The aim was to find a solution that would ensure the loads on the pinions are distributed at the right place, in the centre of the teeth, even if the deformations are present.

As a result, the excessive vibrations had fully disappeared. The bearings are no longer affected and the teeth are no longer subjected to degradation.

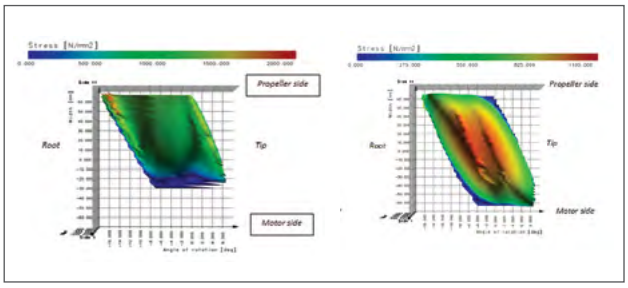
Conclusion

This case study describes how a logical failure analysis approach can help in understanding the failure of power transmission components, by indicating the probable causes as well as proposing the right corrective actions and palliative measures.

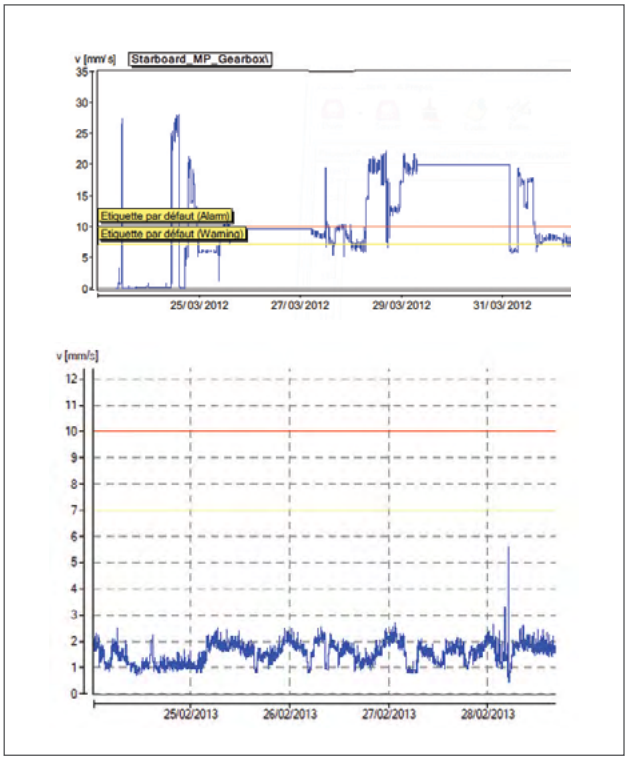
Moreover, the implementation of an appropriate method, using powerful and extensive software, makes it possible to confirm the cause of the failure. This is achieved by combining the global approach and detailed component analysis, in order to get a further understanding of gear mesh behaviour during operating conditions.



Modelling of gearbox.



Stress distribution on pinion tooth flank (before and after modifications).



Level of vibrations, measured before and after optimisation of tooth flank modifications.

(This article is based on a presentation made by Mr Robert Shandro at the webinar titled 'Power Transmission - From Failure to Re-Design', organised by the Institution of Engineers, Singapore (IES) and held on 29 July 2020).

All images by Cetim-Matcor, unless otherwise stated.

DESIGNING A WATER NETWORK

FOR A HARSH DESERT ENVIRONMENT

Software applications helped successfully deliver the project within 88% of the initially proposed budget.

Layout of the Al-Wajeed Water Treatment Plant.

Providing water in the desert

The Rub' al Khali, also known as the Empty Quarter, is a sand desert that covers about 650,000 km² of the southern Arabian Peninsula, stretching into parts of Saudi Arabia, Oman, the United Arab Emirates, and Yemen.

Saudi Arabia developed the master plan for the Al-Wajeed Water Treatment Plant to safeguard the well-being of over half a million people living in or near the Rub' al Khali, who are affected by drought conditions. These conditions have become exacerbated by pollution and the drying-up of local wells, which is why the initiative to develop a water network is so important to the region.

As part of Saudi Arabia's Vision 2030 Initiative, the USD 500 million project involved the construction of a world-class treatment plant and conveyance system with a capacity of 68,000 m³ per day for Phase One, which would be upgraded to a capacity of 108,000 m³ per day in a later phase. All concrete works and infrastructure, however, would need to be completed in Phase One, including 600 km of water pipelines, high-volume reservoirs and access roads.

As the lead in the design and construction of this project, Khatib & Alami faced numerous challenges, many stemming from the harsh climate of the desert where the water system would be located. Access roads to the site needed to be designed and built in a way to protect them from moving sand dunes. Also, the transmission line needed to pass through sand dune areas, meaning that the team would need to coordinate the design with the construction team and the pipe supplier.

Khatib & Alami would need to work to resolve the unstable dune material, establish a strong road along the pipeline for access, and provide a concrete base that considered the depth of the pipes and the accumulation of future sand dunes.

Importing GIS data for better decision-making

Khatib & Alami began by developing a GIS asset registry of existing wet and dry utilities, as well as population data and other information that would significantly impact the design. Using this data was essential when the team began developing the hydraulic model of the entire system and considered multiple alternatives and operational scenarios based on the harsh conditions.

Khatib & Alami chose Bentley's OpenFlows applications to manage all this data, for design, analysis, optimisation, and decision support. The team began by importing all the digital data from the GIS registry - including network infrastructure and topology, location and status of valves, and characteristics and attributes of pipes, pumps, and pressure loggers - into OpenFlows WaterGEMS. In this way, any change in the asset registry would be reflected in the hydraulic model, and vice versa. By using this application, the team created an optimised hydraulic model that included the local water source, multiple pump stations, and collection reservoirs.

Developing optimised hydraulic designs

By using OpenFlows WaterGEMS, Khatib & Alami also optimised the hydraulic designs of the tanker filling stations. These designs were important because, previously, some of water networks in the cities near the Rub' al Khali failed to meet the necessary water demands. With the new, updated design created in OpenFlows WaterGEMS, the networks would feed the required amount of water to the reservoirs in these cities, which were connected to elevated water tanks that would feed the multiple filling stations by gravity.

The project team was also able to conduct extended period simulation by using OpenFlows WaterGEMS. This capability helped Khatib & Alami optimise the network's hydraulic performance by scheduling pump operation and ensuring that the water tanks are filled with the required amount of water. By building the hydraulic model with OpenFlows WaterGEMS, the team could visualise the entire transmission system, including where all the electromechanical equipment would be located once construction was complete. Also, using OpenFlows applications, Khatib & Alami developed a filtration system to remove contaminants. Additionally, the team used OpenFlows SewerGEMS to model the sanitary network. By optimising the hydraulic designs using OpenFlows applications, the team was able to reduce its drawing time and production efforts.

Modelling system components for innovative solutions

Once a steady-state hydraulic model and all the information was input into OpenFlows WaterGEMS, the team modelled the transmission system's components using OpenFlows HAMMER. This practice allowed team members to check the system performance under all types of conditions, such as power failure to the pumps or motor sets. The team could also ensure that the design provided the required protection elements, including surge vessels, open surge tanks, surge valve anticipators, and pressure relief valves.

By modelling the components in this application, the team was able to simulate design options and create innovative solutions. One example involves the installation of an inverted U at the raw water tanks' inlets to minimise the surge vessel volumes at each well. This installation led to a maintenance-free, anti-surge device.

Delivering an award-winning project in the region

By using OpenFlows applications, the team at Khatib & Alami reduced design modifications by 25%, saving 10,000 resource hours, and delivering the project within 88% of the initially proposed budget. The inverted-U anti-surge devices proposed on OpenFlows HAMMER significantly reduced the lifecycle cost and minimised the surge vessel volumes at each well, helping to reduce the total construction cost by USD 500,000. OpenFlows applications also helped the team realise that it could use excavated material to backfill pipe trenches, which it did on 70% of the trenches, saving USD 3 million in construction costs. Due to these significant results, the project won numerous awards, including the Infrastructure Project of the Year Award at the prestigious Construction Week Awards 2018.

The highly complex Al-Wajeed Water Treatment Plant has been a major socio-economic catalyst for infrastructure development in a part of the country previously viewed as unreachable for investment opportunities. This project employed over 2,000 workers at its peak and is expected to last for many years, despite extremely harsh desert conditions. The project has spurred further growth in the area, showing opportunities for future development while also ensuring the safety and well-being of a population of half a million and growing.

PROJECT DATA

Project
Al-Wajeed Water Treatment Plant

Location
Al-Wajeed, Tathleeth and Bisha, Asir Region, Saudi Arabia

Designer
Khatib & Alami

Project Objectives
- To design a treatment plant and conveyance system amidst harsh desert conditions.
- To produce a design model that would allow for effective communication between all project participants.

Products Used
- OpenFlows FLOOD
- OpenFlows HAMMER
- OpenFlows SewerGEMS
- OpenFlows WaterGEMS

C-ASTRA ROBOT

DEACTIVATES AND DESTROYS VIRUSES

The COVID-19 outbreak has generated a massive need to disinfect surroundings fast. Surfaces contaminated with COVID-19 pose a grave threat to the safety of healthcare workers, patients, frontline responders and the general public.

Deactivating the COVID-19 virus on surfaces is a critical and necessary step to protect and disinfect, especially when businesses have resumed and workplaces have re-opened. There is, therefore, an urgent demand for deep cleaning and disinfection services in Singapore.

To meet this demand, Omni-Health, a Singapore-based health automation distributor, has brought in the C-Astra Autonomous disinfection robot, developed and manufactured by India-based healthcare technology corporation, Invento Robotics.

Semi-autonomous operation

The C-Astra differs from other disinfection robots currently in the market, which are primarily used only to clean and vacuum floor surfaces, and require manual operation to move them around. Furthermore, they are unable to disinfect surfaces that they do not come into contact with.

The C-Astra can navigate semi-autonomously in any environment, using the Light Detection and Ranging (LIDAR) and Simultaneous Localisation and Mapping (SLAM) technology, while the operator can control the robot from up to 30 m, via a mobile application.

The robot has six ultraviolet (UV) lamps which help to destroy 99% of viruses, including the COVID-19 virus. This removes the need for cleaners to be in contact with surfaces, thereby reducing the risk of getting infected.

The use of the Human In The Loop system enables operators to remotely assist the unit if it gets stuck, and to monitor the unit for safety. This reduces human contact of the robot in areas that require disinfection, thereby reducing the chance of cross-infection. The unit can run up to six hours continuously on a rechargeable battery pack which takes four hours to charge.

Through a novel fleet management system, individual units can be monitored around the hospital, office or retail location, and it enables data collection and management to be performed remotely by a professional.

Designed for use in a variety of spaces

Hospitals, medical office buildings, isolation facilities and even public places such as shopping malls and community spaces can benefit immediately from C-Astra disinfection, as the global pandemic demonstrates the need for quick and effective disinfection.

C-Astra robot has been used in several hospitals in India, including the Apollo Hospital in Chennai. Moving forward, Omni-Health hopes to bring more of these units to health institutions and facility management companies in Singapore.

The C-Astra Robot

Covid- 19 Disinfection Percentage OW	99.0%
Mode of System	Autonomous Robot
UV Light Specification	Wave Length 253.7 Nanometres
Type of Movement Automatic / Manual	Automatic Remote control via an app
Distinguish Humans	Alarm on identifying a movement
Disinfection Reports	Report Available
User Interface	User Interface with Navigation Status
Data Storage	Cloud Data Storage
Mobility Engine	A Wheelbase with an Engine
Area Coverage	360 Degrees
Speed	Up to 4.0 Km/H
Full Charging Duration	4 Hours (6 Working Hoursl
Wireless Connectivity	Via Wi-Fi
Total Weight	50 Kg
Mapping Facility	Yes
Method of Disinfection	UVC Dry & Chemical Free
Time of Disinfection	5 Continuous Hours
Remote Control.	Via App
Life Span of UV Lights	9,000 Hours

Technical specifications of the robot.

MAJOR VERSION UPDATE OF ROBOTMASTER

ROBOTIC SOFTWARE NOW AVAILABLE

Hypertherm, a US-based manufacturer of industrial cutting systems and software, recently announced the release of Robotmaster Version 7.3 offline robot programming software with extensive features and enhancements designed to further simplify robotic programming.

Additions found in V7.3 include:

- Support for the newest CAD file types, 3D printing software, and third-party plug-ins for software brands such as CATIA, SolidWorks, Autodesk Inventor, Siemens, Solid Edge, AutoCAD, Pro-E/Creo, Rhino, and more.
- Performance improvements for faster data processing and robot code output when creating additive manufacturing paths in addition to post processor enhancements for major robot brands such as Kuka, ABB, and Fanuc.
- The addition of new modules including a spray simulation module for companies which use robots to spray, coat, or paint products, as well as a module that simulates material deposition during additive manufacturing, adhesive dispensing, welding, and similar applications.
- Numerous productivity enhancements to existing modules for more accurate time estimates, the ability to quickly import g-code from 3D slicing software including Cura and Slic3r, and the ability to automatically set a cutting direction based on material location with respect to the path.
- Notable enhancements to the path import module providing users with an option to read custom instructions and set process activations and deactivations directly from imported code and enjoy a more accurate interaction, process simulation, and robot code output for both g-code and APT formats.

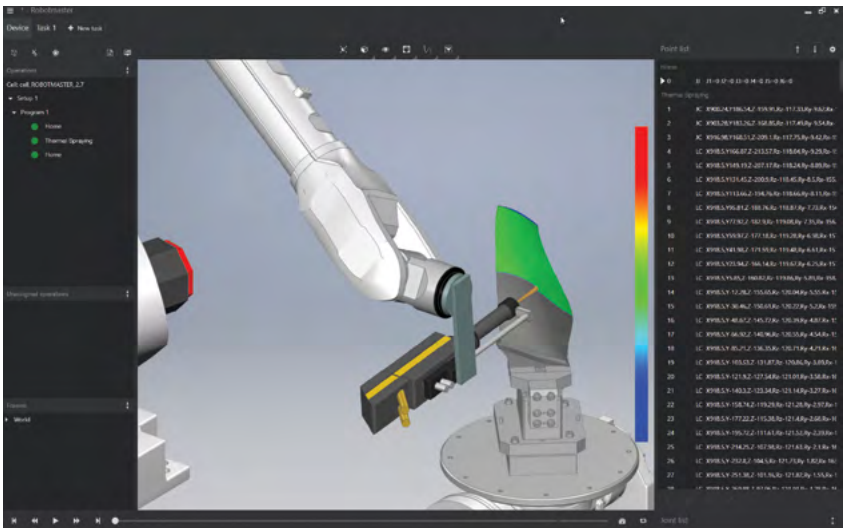
"The many new features found in V7.3 are based on close work with many of our current customers to understand how we can further streamline offline robotic programming. By adding support for more software types, files, and robots, we are helping customers solve sometimes complex challenges quickly and easily", said Garen Cakmak, Leader of Hypertherm's Robotic Software Team.

Building upon the completely redesigned V7 architecture, first introduced in 2018, Robotmaster uses integrated CAD/CAM functionality to make robotic programming easy and intuitive for everyone, even first-time users. It is used by a wide range of industries to program robots for tasks that include surfacing, 3D milling, additive manufacturing, welding, painting, and more.

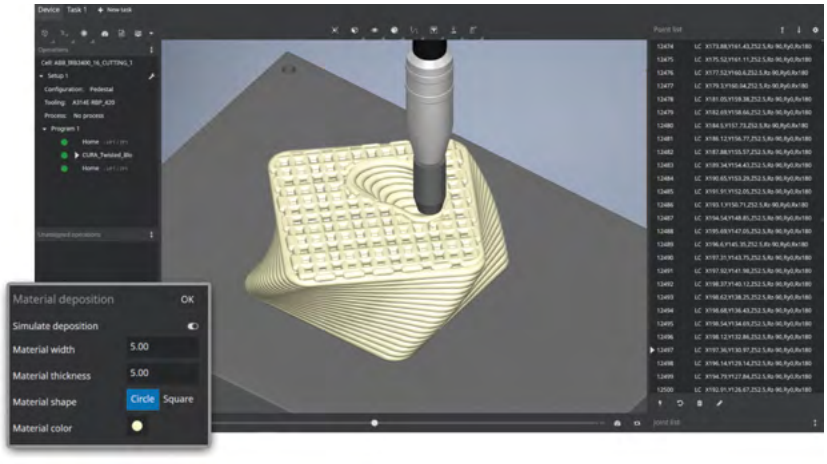
Robotmaster software

Hypertherm's Robotic Software team developed Robotmaster, a CAD/CAM based offline robot programming software. Its architecture harnesses robot flexibility to exploit the full capabilities of any robotic cell, while improving the profitability of high-mix, low-volume productions.

Hypertherm designs and manufactures industrial cutting products for use in a variety of industries.



Robotmaster V7.3 includes the addition of new modules including a spray simulation module for companies which use robots to spray, coat, or paint products.



Module simulating material deposition during additive manufacturing.

FIRST CATALOGUE RANGE

OF INTELLIGENT PLAIN BEARINGS LAUNCHED

A leading international manufacturer of energy chain systems and polymer plain bearings, igus, has now developed its first isense plain bearing series with five 'iglidur' materials for predictive maintenance.

Whether in the food industry, textile machines, forklifts or construction machines, with the intelligent 'isense' plain bearings, users receive a durable and lubrication-free solution that provides information about their wear. Maintenance can be planned in good time, and machine and system failures are prevented.

Wear-resistant parts such as plain bearings must withstand extreme loads in machines and plant. If one of these bearings fails, there will be trouble.

For this reason, igus presented the first study of an intelligent plain bearing at the Hannover Messe 2019.

Technology integrated in the bearing detects wear in advance and gives the user a signal in good time, when the wear limit is reached.

After many series of tests in the company's 3,800 m^2 in-house test laboratory, igus has now developed the first isense standard range for its lubrication-free iglidur plain bearings.

The catalogue range includes five materials with which a large part of highly stressed applications can be covered. They are the FDA-compliant material, iglidur A180, which is specifically designed for use in the food industry; the heavy-duty bearing, iglidur Q2E, for use in construction machinery and agricultural engineering; the all-rounder material, iglidur G; the endurance runner, iglidur J; as well as iglidur P210, for pivoting and rolling applications.

All the intelligent plain bearings are offered in three dimensions - each with an inner diameter of 20 mm, 30 mm or 40 mm.

System connection according to customer requirements

To connect the isense plain bearings, igus has four suitable cables with an oil-resistant and media-resistant PUR outer jacket, in four standard lengths, from 1 m to 10 m, in its portfolio. In addition, the user has the choice between two connector types.

The sensor-measured data can be integrated by the machine and equipment operators into their systems, in different ways. Three readout units are offered for this purpose. Either the user can manually read out all plug-in points, or install a control unit with a red/green display on the machine, which provides information about the condition of the plain bearings.

Another possibility is the connection to icom.plus. For this purpose, a radio module sends the sensor data by wireless transmission to the communication module. From here, the integration of data to the IoT, cloud system or to the customer network is possible on a wire-bound basis.

The customer has the freedom to choose the most suitable way to read the data.

From forklifts to packaging machines: isense plain bearings provide information about their wear, and warn, in good time, before the stoppage of plant or machinery. Image: igus GmbH.

RAILWAY SYSTEMS HANDBOOK

Edited by:
Pang Hock Lye, John
Cheong Mun Kit, Eric

Published by: THE INSTITUTION OF ENGINEERS, SINGAPORE

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IES VISIT TO THK HOME FOR THE DISABLED @ EUNOS

From time to time, the IES Community Service Committee (CSC) organises visits to various Homes, as part of our Institution's corporate social responsibility to care for the underprivileged.

On Saturday, 10 October 2020, members of the committee visited Thye Hua Kwan (THK) Home for the Disabled @ Eunos, laden with goodies, board games, stationery and mooncakes sponsored by Sunlight Electrical Pte Ltd.

They presented the residents with goodie bags of said items, as well as dental kits and toothpaste sponsored by local brand Pearlie White.

The THK Home's management observed that the bags were filled to the brim with lovely and useful items. On receiving the goodie bags, the residents incessantly expressed their appreciation.

"The Home deeply appreciates the charitable spirit and support from IES and the sponsors, especially in these trying times with COVID-19," said Mr Edwin Fu, Superintendent, THK Home for the Disabled @ Eunos.

If you would like to contribute your time and energy with the CSC for a good cause, kindly write in to the Secretariat at **ies@iesnet.org.sg**. We will link you up shortly. Thank you!

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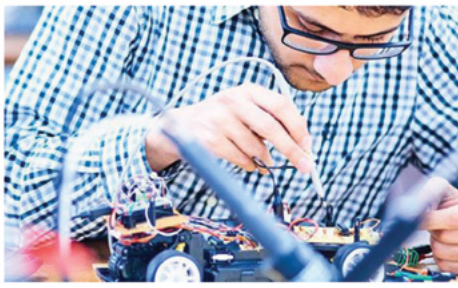

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