



e-tech

news & views from the IEC

The year in review

TECHNOLOGY FOCUS

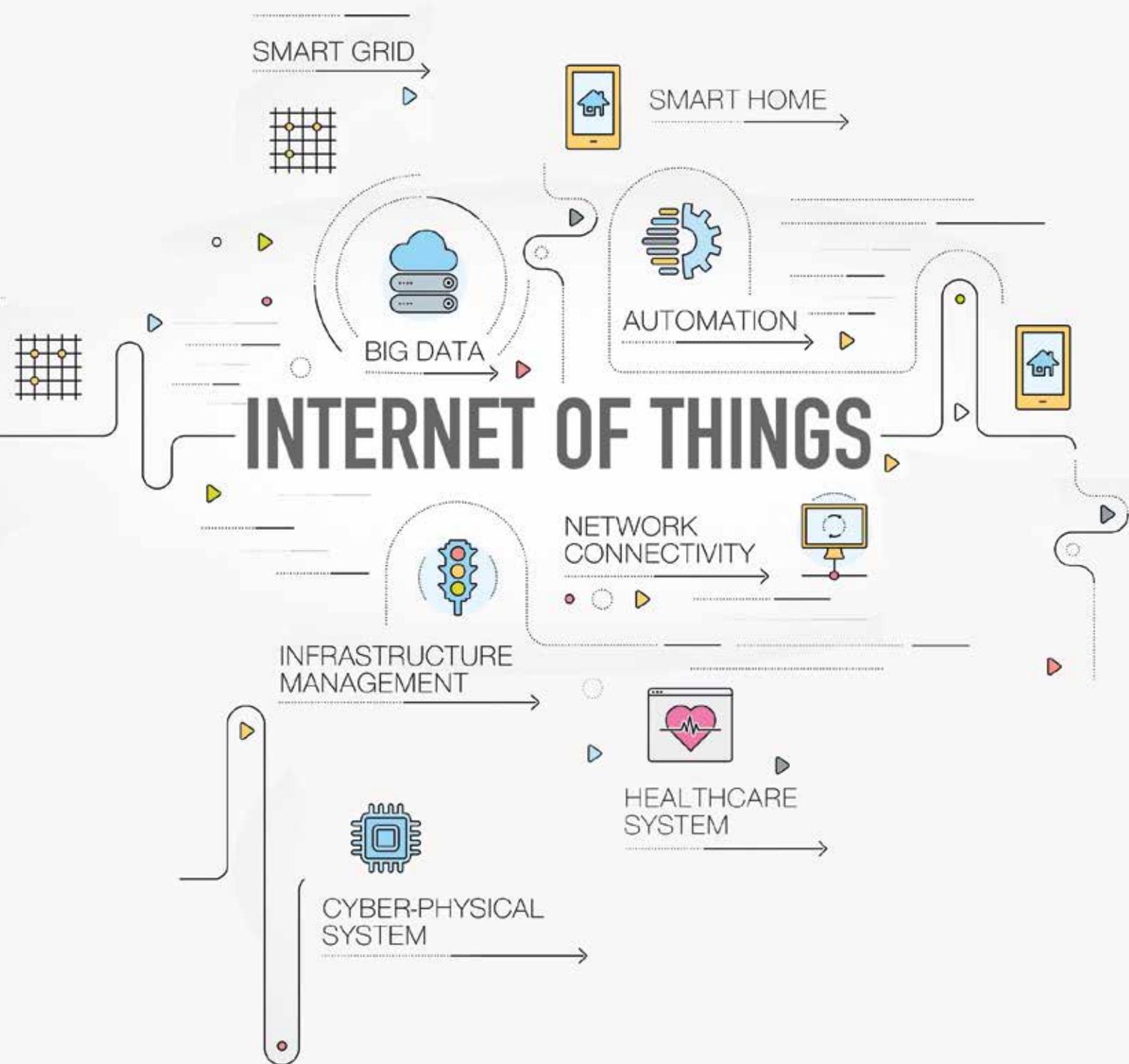
AAL: Independence day!
Driving the future
IEC work crucial for disaster relief

INDUSTRY SPOTLIGHT

Air transport, EE and the environment

IEC FAMILY

Affiliate, regional centres and
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Standards that count and build trust

Message from Frans Vreeswijk, IEC General Secretary & CEO

By Frans Vreeswijk

Once upon a time standardization was simple and straightforward. Most products didn't contain electronic interfaces, they were either mechanical or electrical, and most were not connected. More recently, and especially with the internet of things (IoT), this has dramatically changed.

The speed of innovation has accelerated to a point where individual companies are no longer able to develop everything alone; systems are becoming increasingly complex and require large integrated technology solutions. Conformity assessment is more essential than ever to ensure that Standards are implemented correctly and outcomes can be trusted. In today's world companies are fiercely competitive and yet they have to

collaborate more than ever before. This cooperation is only possible when all actors work along the same generally agreed technical rules so that technologies are able to connect and broad solutions can be built, integrated and trusted.

This holds two key messages for us all:

- Cooperation is now the rule, not the exception
- Nobody can do everything alone anymore

This directly impacts how we work in the IEC. To address increasing complexity, we all need to reach out to others in and outside the IEC and bring their expertise and know-how on board. Ensuring the suitability and



Frans Vreeswijk - IEC General Secretary & CEO

use of IEC work are also important messages in the new IEC Masterplan, which will be launched in Vladivostok during the IEC General Meeting.

With the acceleration in technology convergence, no single technical committee (TC) will be able to do everything alone anymore. Systems committees aim to support TCs in coordinating inputs and outcomes so as to develop systems deliverables that satisfy these new market requirements. The systems approach should be seen as an important enabler that will allow technical committees to output work that continues to satisfy real market needs.

I thank you all for your work and your commitment and wish you a fruitful General Meeting.

Frans W. P. Vreeswijk



Cooperation is now the rule, not the exception



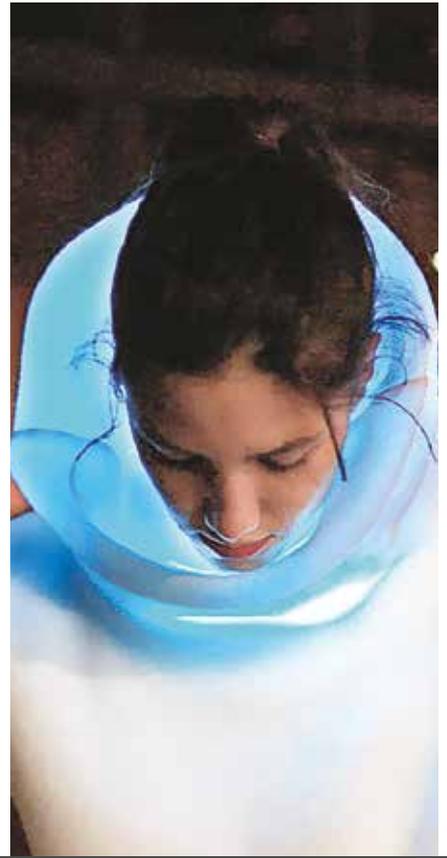
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Issue 06/2017 focuses on the 12 months since the IEC General Meeting in Frankfurt, Germany, and highlights most of the technologies and TC work that were featured in *e-tech*. It provides an update on the IEC Conformity Assessment Systems, the IEC Young Professionals, the Affiliate Country Programme and the IEC regional centres and reviews some of the major events the IEC participated in.



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A new kind of training

Simulation technology is safe and cuts costs

By Antoinette Price

Modern virtual reality (VR) technology has its origins in the military, and later gaming industries. Many sectors use VR applications to improve business and enhance workplace safety. Some examples include aerospace, advertising, automotive, broadcasting, construction, entertainment, medical, retail and tourism.

However the number is growing and the technology is expected to boom. Augmented reality (AR) and VR could hit USD 150 billion revenue by 2020, (AR: USD 120 billion and VR: USD 30 billion), according to a report by Digi-Capital, a company advising AR/VR, mobile and games leaders in Asia, Europe and the US.

Disrupting another industry

Rethinking teaching and learning methods through technology is already bringing benefits to the education industry. VR programmes are redefining the classroom, connecting experts and students across the world like never before, and delivering unforgettable lessons. Workplace training has become far more hands-

on and effective, resulting in improved performance and safety.

Standards behind the technology

VR displays follow the technology of smartphones. The hardware is comprised of gyroscopes and motion sensors for tracking body, hand and head positions, small screen displays and fast processors. Headsets continue to advance, thanks to 360-degree cameras, which can produce VR images and video in all directions.

A number of IEC technical committees (TCs) and their subcommittees (SCs) produce International Standards and have testing systems which help ensure the reliability, safety, efficiency, interoperability and quality of the components within this technology.

ISO/IEC JTC 1, the Joint Technical Committee of IEC and the International Organization for Standardization (ISO), covers standardization for information technology. ISO/IEC JTC 1/SC 24 works on interfaces for information technology-based applications relating to computer graphics and virtual reality, image processing,



environmental data representation, support for mixed and augmented reality, interaction with, and visual presentation of information.

ISO/IEC JTC 1/SC 29 covers coding of audio, picture, multimedia and hypermedia information. It has published International Standard ISO/IEC 23000-13, which focuses on the data formats used to provide an AR presentation using 2D/3D multimedia content.

Sensors and microelectromechanical systems (MEMS) are vital to VR. IEC TC 47 and IEC SC 47F ensure they are reliable and efficient. IEC TC 100 produces Standards which contribute to the quality and performance of audio, video and multimedia systems and equipment



Taking a virtual field trip in the classroom (Photo: www.teachinglikeits2999.com)

and their interoperability with other systems, while IEC TC 110 covers electronic display devices and certain components, such as dashboard touchscreens in cars.

VR to the rescue

One challenge for emergency service first responders has always been how to get as realistic a training as possible, before experiencing live disasters and emergency situations.

Now, state-of-the-art VR training programmes let users immerse into a seemingly real disaster scenario, with background noise, visual and auditory cues. They can create unique settings and incidents which require users to respond to the specific situation. This hands-on approach is far more

effective than memorizing check lists for possible disasters.

Technology with benefits

In Australia, Europe and North America more fire brigades, police and ambulance services area using VR training programmes which are:

- Safe – trainees can practise real-life skills in a safe environment
- Efficient – individuals and agencies can train alone or together
- Comprehensive – predesigned modules cover all types of situations
- Cost effective – special environments don't need to be built nor people transported. It can be used multiple times and may be offered for free to emergency

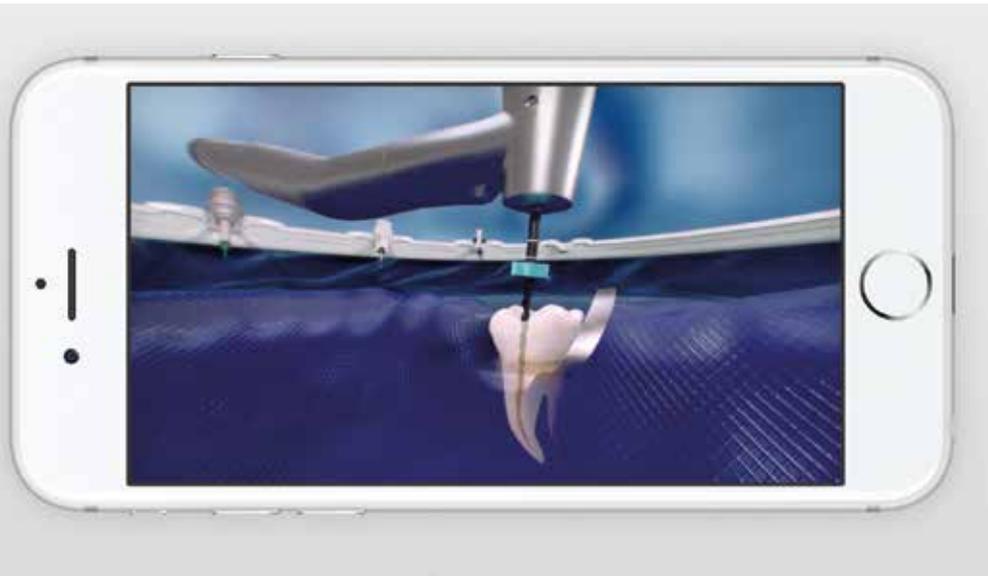
services

- Tailored – response agencies can tailor open source platforms to their requirements, infrastructure and available resources

One VR training “game” was created to prepare medical staff being sent to the field during the Ebola outbreaks across Africa between 2013 and 2016. Users could play as often as they liked, learning vital life-saving procedures, which by the time they arrived in the medical camps, would be second nature.

Test driving behind the virtual wheel

As we inch closer to a world of fully autonomous vehicles, more testing and development is still required on the vehicles themselves, and the



VR dental applications improve surgery techniques (Photo: www.coltene.com)

intelligent infrastructures they will require in order to function smoothly. However, it seems consumers will only adopt this technology on a broad scale once they feel it is safe.

As well as road testing, VR programmes are being used to train drivers safely, allow authorities and car manufacturers to carry out road safety research, and test specific vehicles, such as electric vehicles.

Authorities and planners of smart urban transport systems also benefit from these apps, which allow them to create accurate, realistic 3D models of future, fully smart environments.

How does it work?

VR application software allows programmes to be adapted using:

- Plug-ins to vary vehicle dynamics systems and controls (lights and acceleration)
- Eye tracking to measure the driver's eye position and movement. Researchers can test drivers with some forms of vision impairment to improve vehicle design

- Imported laser-scanned data for the 3D models and free world maps contain roads, tunnels and bridges used to create the precise 3D models

Captivating virtual lessons

Forget the books, students can don headsets and learn anatomy from inside the body. It's far more engaging. An innovative VR app lets students "touch" cells, move the 3D images around and gain a completely new perspective.

Equally, VR makes it possible to walk through history, back to a simulated and very realistic point in time, or travel into space and discover the solar system, as if really there. Experiencing, rather than reading or listening to a teacher, makes it more interesting and easier to remember facts.

Cutting-edge pre-surgery training

In the medical world, students may pass the theory, but how well do they perform surgery, and how can this be assessed before they operate on patients?

Merged reality (MR) is the blending of the real and virtual worlds with objects that interact from both. The result is bespoke applications, which improve surgery performance and increase success rates.

For example, at a prominent UK dental school, VR applications let students choose the tooth, the type of surgery and practise as much as they like. They also receive performance ratings. This is achieved using a mirror and haptic dental drill with feedback technology, which enable trainees to sense touch and force in a VR environment, as they operate on virtual 3D teeth shown on a screen. A real foot pedal controls the drill speed and settings, while eye glasses track head movement so that the 3D model on the screen moves relative to the head movement.

Connect and learn

Geography is no longer an issue, as teachers and lecturers beam themselves to audiences in other countries using the latest VR technology.

For example, 360-degree camera rigs and microphones on a surgeon's head film and stream complicated operations to students and professionals worldwide. The surgeon explains his way through each part of the procedure, as students observe from angles they normally would not have access to. They can also play the recording back multiple times.

Another VR platform offers interactive virtual trainings on diverse subjects, anywhere, for up to 30 individuals simultaneously. Instructors can observe and provide feedback, in real time, to students who interact with avatars. One way this has been used is for training healthcare workers in Africa for emergency care for infants.

Helping prevent a cyber nightmare

With daily cyber attacks on the increase and reaching all areas, IEC work is essential to prevent or, fails this, mitigate their impact

By Morand Fachot

Standardization work by IEC technical committees (TCs) and subcommittees (SCs), and by the Joint Technical Committee (ISO/IEC JTC 1) set up by the IEC and the International Organization for Standardization (ISO), is meant to prevent and mitigate the catastrophic impact of cyber attacks on parts of the critical infrastructure everywhere. In addition, IECCE, the IEC System for Conformity Assessment Schemes for Electrotechnical Equipment and Components, is working on a generic conformity assessment (CA) model which can be applied to cyber security.

Objectives, actors and tools

The number of cyber attacks on countries, companies, organizations and individuals is increasingly constantly.

Many actors are behind these, they are often difficult to identify, let alone catch. Their motives are often intertwined and they are loosely organized. They include, among others:

- Individuals or organized groups determined to steal money – through embezzlement or ransomware, which encrypts a computer's files which can only be unlocked after payment – or information, or to block personal or corporate IT systems
- Companies ready to steal competitors' confidential information, either technical or trade-related to gain competitive advantage
- Individuals or groups bent on disrupting operations of an organization, government or bringing them into disrepute.
- State and non-state actors (the latter acting on their own or on behalf of a state) bent on wreaking



Simulations are part of current best practices for modelling built environments (Photo: Forum8)



The AP Moller-Maersk shipping group disclosed that the June 2017 NotPetya cyber attack, which disrupted its operations, could end up costing it USD 200-300 million.

havoc on another country's infrastructure or on companies of which they disapprove

The IT tools employed to mount cyber attacks are varied and depend on the target. They can be combined to achieve maximum effectiveness and often rely on insufficient protection of systems, including failure to update software and a general lack of awareness from users in the targeted systems.

Very damaging and costly

Attacks on corporate IT systems can have a very adverse impact on businesses (loss of corporate information, reputational damage,

etc.) in addition to possible significant financial losses.

A recent example shows that the potential cost may reach into hundreds of millions. The AP Moller-Maersk shipping group disclosed on 16 August 2017 that the June 2017 NotPetya cyber attack, which disrupted its operations, could end up costing it USD 200-300 million.

The company reported on 16 August 2017 that its underlying profit for the second quarter of 2017 was USD 389 million.

The current economic cost of cyber attacks is already shockingly high and is set to double within a few

years, according to a 2016 report by the Cybersecurity Ventures research company, which forecast that annual costs related to cyber incidents will be as high as USD 6 000 million in 2021, up from USD 3 000 million in 2016.

Economic losses may be staggering, but potentially more serious would be a catastrophic failure of parts of a country's critical infrastructure. Critical infrastructure is generally seen as including all or most of the following:

- Energy supply (generation, transmission and distribution)
- Financial services
- Industrial controls systems
- Healthcare



ion (Photo: AP Moller-Maersk)

- Telecommunications
- Information technology (IT)
- Insurance

Critical installations such as power networks are often insufficiently protected in many countries.

Top down and horizontal approach and protection

International Standards are key to the protection of critical infrastructure systems.

Many organizations rely on the ISO/IEC 27000 family of International Standards for information security management systems (ISMS) to keep their information assets secure. This

family of Standards is being developed by ISO/IEC JTC 1/SC 27: IT security techniques.

As of September 2017 there were some 45 publications in the ISO/IEC 27000 family of International Standards for ISMS.

For its part the IEC, through a number of its TCs and SCs, develops many cyber security-related International Standards and other publications for specific systems and applications. Some may apply to different areas, others are relevant to one domain only.

IEC cyber security-related International Standards are implemented in many different critical infrastructure areas such as:

- Power systems
- Industrial automation
- Nuclear power plants
- Healthcare
- Transportation (maritime, road and railways)

As more and more components in the home and industrial environments get connected and communicate with each other, in what is known as the internet of things (IoT) more security concerns emerge as larger systems may be targeted through their connected components. In addition to the deployment of existing Standards a new holistic approach is required in many instances.

Standardization work across the IEC

The following IEC TCs and SCs prepare International Standards that protect specific domains and make industry and critical infrastructure assets more secure:

IEC TC 57: Power systems management and associated

information exchange, develops, among many others, the IEC 61850 series of publications for communication networks and systems for power utility automation, and the IEC 60870 series for telecontrol equipment and systems.

These Standards are particularly important for critical infrastructure. Two cyber attacks on Ukrainian power networks in December 2015 and 2016 targeted Standards in both series. Likewise, at the recent BlackHat USA event, vulnerabilities in Standards from these series that make it possible to hack into wind turbines control systems and take down entire installations were exposed. TC 57 is aware of this issue and constantly reviews Standards to ensure all potential vulnerabilities are dealt with.

IEC TC 65: Industrial-process measurement, control and automation, prepares publications that specify security requirements for industrial automation and control systems (IACS) in the IEC 62443 series. The IEC 62443 family has been identified as a generic series for cyber security which can be applied to nearly all electrotechnical products and systems and not only to industrial automation products and systems.

IEC SC 45A: Instrumentation, control, and electrical systems of nuclear facilities, has issued two publications on requirements for security programmes for computer-based systems and on requirements for coordinating safety and cyber security. It is developing more publications connected to cyber security for nuclear facilities.

IEC TC 62: Electrical equipment in medical practice, and its SCs, develops Standards that are intended to protect medical data security, integrity and privacy.



The Los Angeles Hollywood Presbyterian Medical Center computer systems were locked by ransomware (Photo: Junkyardsparkle, via Wikimedia Commons)

Healthcare service providers and insurances have been increasingly targeted by criminals who try to get hold of medical records for fraud and identity theft. In the US more than a third of all data breaches in five industry sectors surveyed concern the healthcare sector, according to the US Identity Theft Resource Center (ITRC).

IEC TC 80: Maritime navigation and radiocommunication equipment and systems, has developed IEC 61162-450:2016, which states that “a shipboard security architecture should comply with information security industry’s best practices”. It has also published an add-on to this Standard, IEC 61162-460:2015. In addition to the ISO/IEC 27000 family,

the “Guidelines on Cyber Security Onboard Ships”, which were adopted recently by the Maritime Safety Committee (MSC) of the International Maritime Organization (IMO), refer specifically to the IEC 62443 series of Standards.

The newly created ISO/IEC JTC 1 SC 41: Internet of things and related technologies, has initiated a study period on IoT trustworthiness. Trustworthiness is a user-oriented systems engineering concept that encompasses all the attributes that would make a system trustable. These include security, availability, sustainability, safety, resilience and privacy. As the number of IoT devices is expected to increase from

8,3 billion units in 2017 to 20,4 billion in 2020, more potential cyber risks are emerging. Work by ISO/IEC JTC 1/SC 41 should help mitigate these risks.

Conformity assessment crucial too

In addition to standardization work by various IEC TCs and SCs and ISO/IEC JTC 1 aimed at protecting systems from cyber attacks, CA is also seen as the next step needed to strengthen cyber defences.

As part of the IEC systems approach, Conformity Assessment Board (CAB) Working Group (WG) 17 is working on drawing up plans for a generic CA model which can be applied to cyber security. IEC CA doesn’t protect as such, but it gives assurances that best practices based on standard requirements have been used and that conformity has been verified and assessed by a third party.

IECEE set up a task force (TF) for cyber security. It has evaluated IEC 62443 for certification purposes and has started work on a CA system based along these requirements. Further developments can be expected on this front in the not too distant future.

Heavy workload ahead

The frequency and extent of cyber attacks, which now affect individuals as well as businesses and even countries, mean that protection will become necessary across a growing range of domains, the more so as more connected systems and IoT devices gain ground. As a result standardization work by IEC TCs and SCs and by ISO/IEC JTC 1 SCs that focuses on cyber protection is set to expand. The same applies to the emerging IECEE CA model for cyber security.

Driving the future

Autonomous and greener means of transport to become ubiquitous

By Catherine Bischofberger

Vehicle makers, telecoms operators and local authorities are planning our future means of transport in big cities, with the help of some key IEC Standards. Self-driving tractors and agribots are changing agriculture in the countryside as well.

Autonomous and connected car-rental services as well as self-driving fleets of electric buses... This is not science-fiction but a future which is about to descend upon us – probably sooner rather than later. Why?

Most large car makers as well as a number of high-tech newcomers have set out plans to introduce self-driving vehicles – cars, taxis, buses or trucks – by the year 2020. The initial technology is based around sensors, radars and cameras. Sensors, in particular, are already widely used in current road vehicles and have become an integral part of engine management, safety systems and climate control. Many sensors use microelectromechanical systems (MEMS).

The IEC is paving the way with a wide number of International Standards. Some come under the



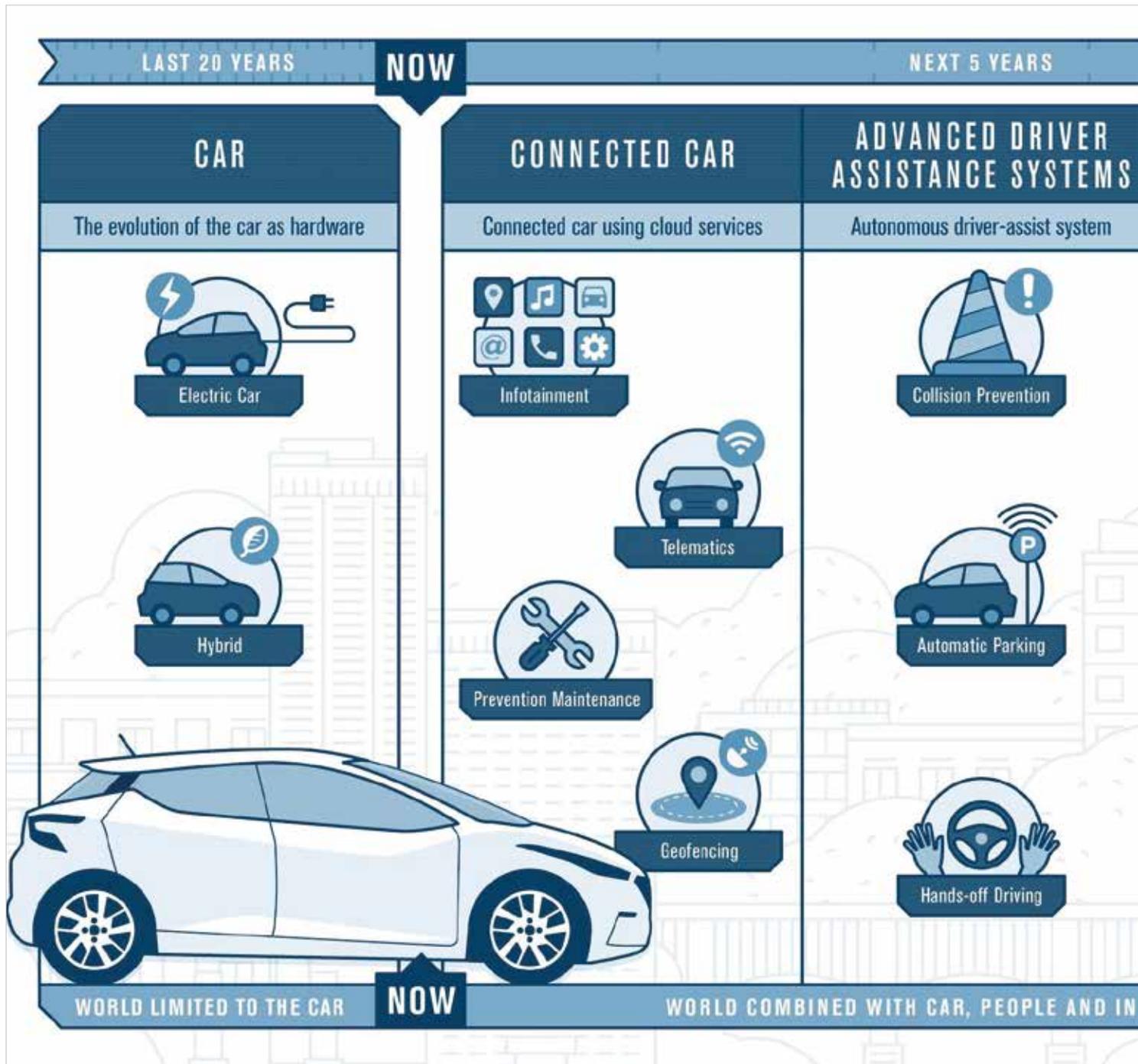
Autonomous cars still have to find a way to overtake on the motorway (Photo: CARJAM TV/YouTube)

remit of IEC Technical Committee (TC) 47: Semiconductor devices, which produces Standards for the use and reuse of sensors as well as testing equipment. MEMS are the focus of Subcommittee (SC) 47 F: Microelectromechanical systems. Anything related to cameras comes under the aegis of TC 100: Audio,

video and multimedia systems and equipment.

Talking vehicles

Telecoms operators are involved too. They are working on vehicle-to-vehicle communications using smartphones. As the Head of Connected Car at



The connected car is a hacker's dream (Infographics: Nissan Motor Corporation)

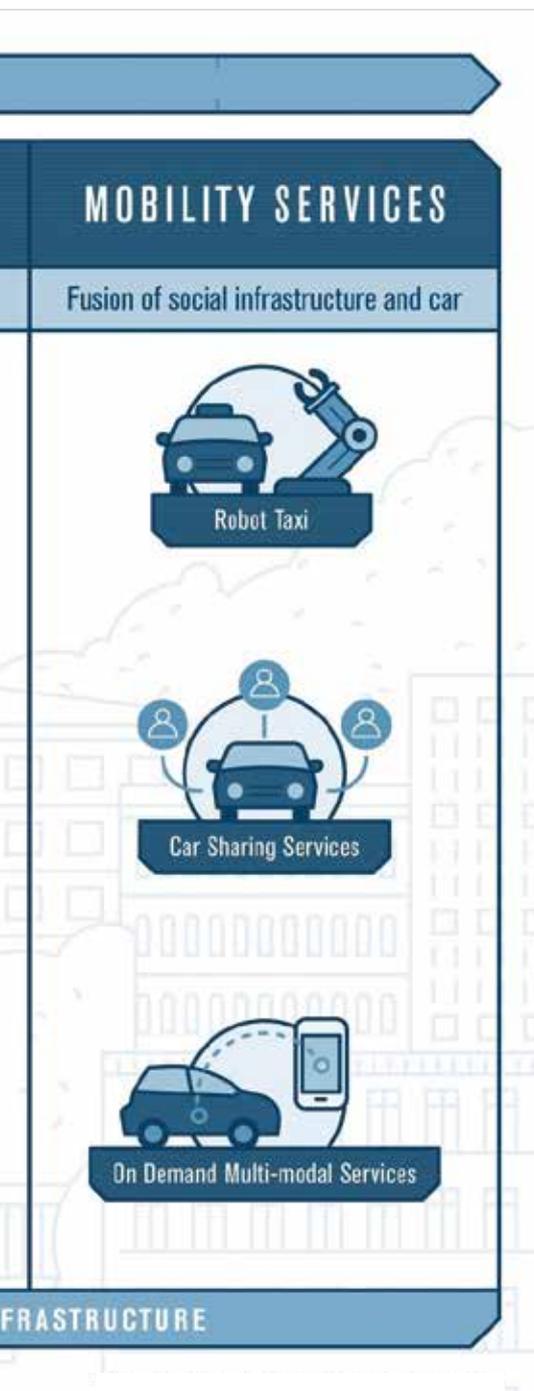
Orange Business Services, Julien Masson explained at a joint ITU-UNECE conference on the future of the networked car held during the 2017 Geneva Motor Show: "Vehicle-to-vehicle communications are one of the ways to help autonomous cars change lanes on highways, which remains a big problem for self-driving technology". Telecoms operators generally are in favour of a server and

cloud-based solution that will enable a high volume of data to be used and exchanged.

One of the problems being tackled is the issue of cyber security: cloud-based and smartphone-controlled operations can be hacked. As Dirk Schlesinger, Chief Technology Officer of TÜV SÜD, an international testing, inspection, auditing and certification

service provider, highlighted at the same conference : "the car of tomorrow is a PC on wheels, but much more challenging".

That is where some IEC Standards come in. The growing risks of connected vehicles being hacked are being addressed jointly by the IEC and the International Organization for Standardization (ISO) through various



subcommittees of their Joint Technical Committee, ISO/IEC JTC 1. For instance, ISO/IEC JTC1/SC 38 deals with cloud computing and distribution platforms.

Other means of transport are not immune to cyber security threats: while piracy has posed a major security challenge to mariners everywhere, since time immemorial, in

the future, threats from armed gangs boarding ships and asking for ransom may be replaced by ones from cyber space. While the maritime industry has yet to record a major cyber incident, it recognizes that it is only a matter of time before some of its assets are targeted.

Mean green machines

Greener means of transport include wirelessly charged electric vehicles based on high-power inductive energy transfer. This takes place between sending components that are buried beneath the road surface and receiving equipment that is installed beneath the vehicle. Wireless power transfer (WPT) requires very little additional infrastructure. In the town of Gumi in South Korea a road has been built which allows buses to recharge while in motion, for instance.

IEC TC 69: Electric road vehicles and electric industrial trucks, is a key player in that field. It has four working groups (WGs). Among these, IEC TC 69/WG 7 works specifically on electric vehicle wireless power transfer systems. WG 7 is focused on IEC 61980, a three-part International Standards series which applies to equipment used in WPT from the supply network to electric road vehicles.

IEC TC 105 prepares International Standards for all fuel cell technologies, including for transportation. Since fuel cells can ideally be used as the main power source for all-electric systems in ground vehicles, ships and aircraft, this TC works with a number of other TCs which contribute to standardization of component parts and systems for transport.

Energy harvesting is another solution envisaged for road transport,

especially when associated with innovative or improved storage systems. In spite of greatly improved fuel consumption, internal combustion engines (ICE) are still inefficient, wasting a large amount of thermal energy coming from the fuel they burn. Various forms of energy recovery can improve the overall efficiency of road vehicles, significantly making them less dependent on fossil fuels and cutting emissions of noxious gases. Urban public transport offers the greatest potential for energy recovery. In some cases, fossil fuels can be replaced entirely.

Hot, hot engine

Among the various forms of energy harvesting, heat recovery from exhaust gases is one of the most ubiquitous. Energy from the exhaust system in the hot engine, which would otherwise be wasted, is converted into electrical energy using thermoelectric generators (TEGs). The energy saved can be used to power a growing number of accessories. TC 47 prepares the Standards for semiconductor devices used in TEGs.

Energy harvested from the sun also offers attractive possibilities. Recently, a leading Japanese car maker introduced a new model of one of its electric vehicles (EVs) with the option of a rooftop photovoltaic system that provides additional power. IEC TC 82: Solar photovoltaic energy systems, develops International Standards which make way for the conversion of solar into electrical energy.

Storage wars

Energy recovered from these different harvesting methods sometimes needs to be stored. Rechargeable batteries are the most mature and widespread storage system for automotive



Agribots are revolutionizing agriculture (Photo: FarmingUK)

applications. TC 21: Secondary cells and batteries prepares the appropriate product Standards in that field. Another useful energy storage system in automotive applications relies on capacitors which store energy electrostatically on the surface of the material rather than chemically as is the case with batteries. Capacitors can capture energy over a very brief period, for instance during braking phases, and release it quickly to boost power or for other uses.

TC 40: Capacitors and resistors for electronic equipment, is working on Standards in that field.

Night and day agribots

Self-driving technology is also used in agriculture. Over the next decade, autonomous hybrid or fully-electric tractors will become widespread. In addition to self-driving, these vehicles must also plant seeds, pick vegetables and apply pesticides.

Leading European and US agricultural machinery companies have launched prototypes of fully-autonomous cables and driverless tractors filled with GPS-guided steering and sensors including radar, laser and light imaging, detection and ranging (LIDAR). Small

electric-powered agribots are already used for planting, seeding and tillage, picking and harvesting, weeding, sorting and packaging and even for pruning vines.

The robots can work night and day and in poor weather conditions. They are battery-powered with electric drive mechanisms and are controlled through cloud-based digital technology.

The IEC is also involved in setting the Standards for agribots, under the remit of TC 47, TC 69, TC 21 as well as ISO/IEC JTC1/SC 38.

Independence Day

How to help people with disabilities be more self-reliant

By Catherine Bischofberger

Using new technology and gadgets to help the elderly and people with disabilities stay independent in and outside the home is the approach favoured by most health specialists, not to mention policymakers and governments. The IEC is preparing International Standards focusing on this approach under the global aegis of its Systems Committee on active assisted living (SyC AAL).

Robot, my friend

Assistive robots with sensory and monitoring functions have been used in healthcare for over a decade. In 2004, Japanese inventor Dr Takanori Shibata created a seal lookalike robot named Paro. The bot made eye contact and had the ability to learn behaviour that elicited a positive response from the user. Things have moved on since then and today's assistive robots can help with a wide array of tasks from bathing to lifting heavy objects, while being able to read facial expressions, obey voiced commands and understand gestures. These robots are equipped with multiple digital cameras and stereo equipment (speakers and microphones). IEC Technical Committee (TC) 100: Audio, video and multimedia systems and equipment,

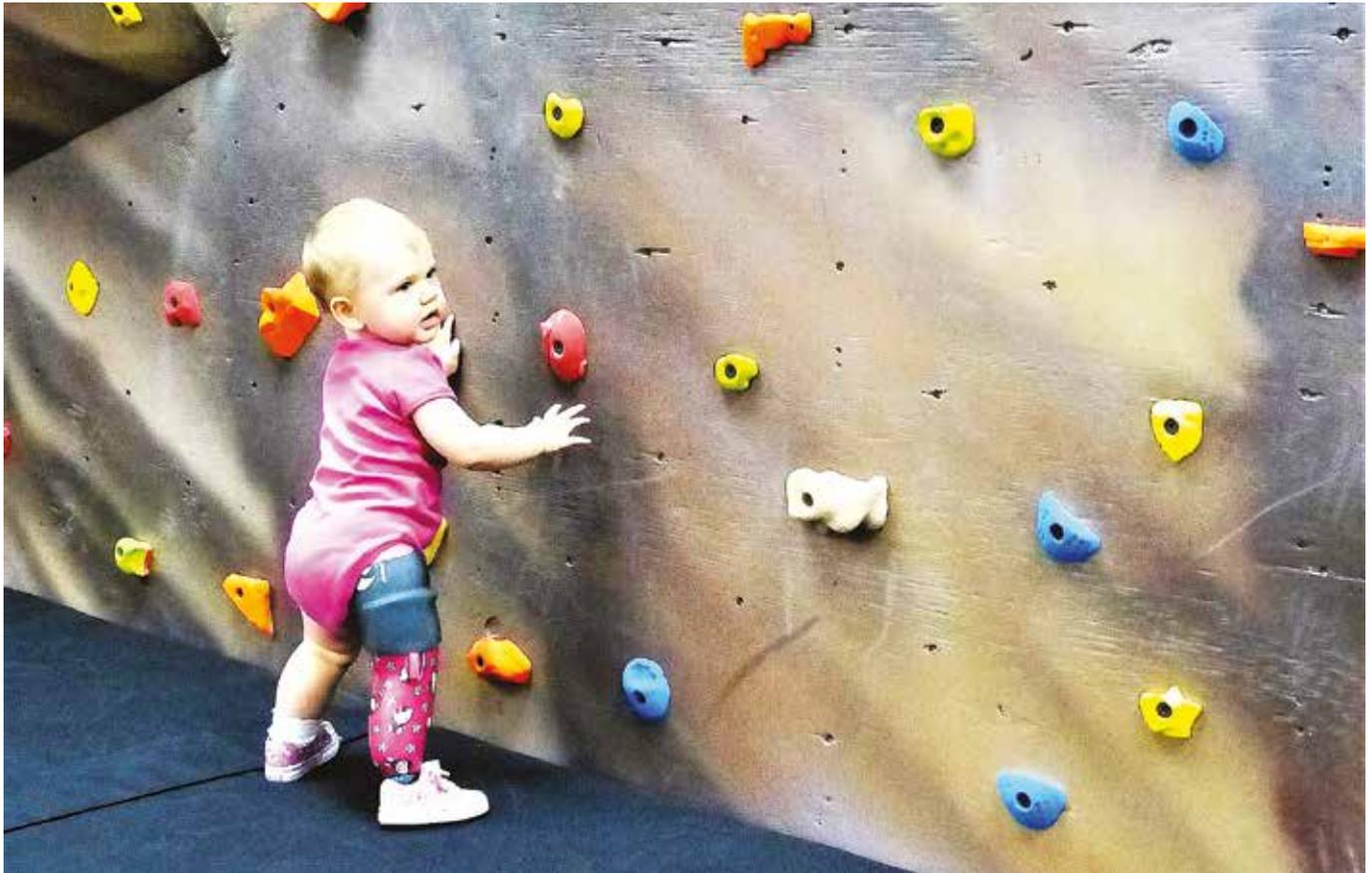


Robots can carry out a wide array of tasks to help disabled and elderly patients (Photo: RIKEN-TRI Collaboration Center for Human-Interactive Robot Research [RTC])

has set up a Technical Area, TA 16: Active assisted living (AAL) accessibility and user interfaces, to address AAL-specific issues.

These robots are also equipped with a variety of sensors, including heart

rate and blood pressure monitors as well as changes in motion, audio and scent detectors which can flag up dangerous situations for people living alone. IEC Subcommittee (SC) 47E: Discrete semiconductor devices, prepares International Standards for



3D printing is making prosthetic limbs easily accessible (Photo: POA/YouTube)

the design, manufacture and use of sensors.

Wheelchair revolution

According to the World Health Organization (WHO), 70 million people in the world require a wheelchair for moving inside and outside their homes but many in the developing world cannot access them because they are too expensive. The organization estimates that only 15% of people in developing countries have a wheelchair. If they do get one, it is highly likely not to be adapted to them in terms of their weight, size or disability.

This situation is starting to evolve thanks to the latest 3D printing and scanning technology. London-based charity Hack On Wheels, for instance, has created an online library of tried and tested open source designs.

People can search the archive to find what they require and get it printed in 3D, making the chair easy to customize and not expensive to produce. In another example, a Vienna-based lab has produced a concept for a child's wheelchair with parametric joints that can actually grow with the child. It includes a backrest made of foam based on a 3D body scan which fits the individual perfectly and makes the chair much more comfortable than it would otherwise be.

In sport, technology is moving fast as well. A recent partnership between industry and UK Sport has produced a state-of-the-art wheelchair for disabled athletes based on several technologies. A leading German automotive manufacturer used a 3D scan of a seated athlete to produce a personalized chair. From the scan, a digital model was made, simulating

the aerodynamic changes that occur when athletes move. This resulted in modifications to the chair frame, reducing its drag by 15%. Drag affects the ability to maintain speed, especially when hitting a headwind or an incline. The chair was run through tests in BAE Systems wind tunnels to assess its aerodynamic efficiency, and its manoeuvrability was measured using tracking technology developed by a prominent Formula 1 racing team.

IEC TC 76: Optical radiation and laser equipment, is preparing Standards in this area, including high-power lasers used in industrial and research applications. Its work is essential for 3D printing and scanning.

The IEC is also paving the way together with the International Organization for Standardization (ISO) on Standards related to 3D printing technology, through a subcommittee

of their Joint Technical Committee ISO/IEC JTC 1: Information technology. IEC/ISO JTC 1/SC 28: Office equipment, works on the standardization of some of the features and the testing of 3D scanners and printers.

Exoskeletons in the closet

Some visionaries like Tesla founder Elon Musk believe that in the near future we will all have to become cyborgs in a world where robots are the norm. While that remains in the realm of science-fiction, exoskeletons and prosthetic limbs are already helping people with disabilities overcome some of the hurdles resulting from their handicap.

Volunteer network e-NABLE puts people needing prosthetic limbs (mostly hands and arms) in contact with volunteer designers and creators who use 3D printing technology to manufacture bespoke artificial joints. A French-based company has created the ALLUX knee, a smart remote-controlled limb. If the user stumbles, electronics take over control of the knee thanks to dedicated

sensors which detect the advent of unsafe situations. Microprocessors immediately increase the hydraulic resistance so as to prevent the knee from suddenly buckling. An inbuilt lithium-ion battery provides sufficient power for between two and four days' use.

The Walk Again Project, a non-profit collaborative undertaking involving Brazilian, German, US and Swiss scientists, develops exoskeletons using the latest technology including virtual reality (VR), enabling the robotic encasing to be powered by the user's brain. An example of their work was famously used by disabled Brazilian athlete Juliano Pinto to kick off the 2014 Football World Cup.

IEC TC 21: Secondary cells and batteries, is focusing on the appropriate Standards for lithium-ion batteries.

Alarm bells ringing

Routinely called the smart home, house interiors featuring multiples alarm systems, sensors, monitoring systems and detectors might appeal

to the geeks among us but have a real usefulness for elderly or disabled people. Security products for AAL environments and smart homes include cameras, motion detectors, door and window sensors and alarms as well as electronic locks and panic buttons.

For instance, smoke detectors adapted for people with hearing impairments alert users by flashing intermittently. If the person is lying down, he or she can be warned by a vibrating alarm under the pillow. The wireless transmitters in some of these systems can also connect to home security systems and send alerts from these. Another useful device is the liquid level indicator that beeps when a cup is nearly full, enabling visually impaired people to do something as simple as make a cup of tea without scalding themselves.

IEC TC 79: Alarm and electronic security systems, prepares International Standards for a wide range of applications and systems including electronic access control, alarm transmission, video surveillance, fire detection and fire alarm systems.

Voice-controlled or motion detector lights, robotic vacuum cleaners, window and blind controllers, emergency phone diallers – all have to be safe and efficient as any faulty apparatus could have disastrous consequences.

The electronic components can be certified as safe and reliable thanks to the IEC Quality Assessment System for Electronic Components (IECQ). The worldwide approval and certification system covers the supply of electronic components, assemblies and associated materials and processes.



Bots are not only useful, they can be fun as well (Photo: Humanoides.fr)

In the home stretch

Wearables are getting increasingly stretchable, small and smart

By Catherine Bischofberger

From smart clothes to talking cows: the IEC prepares Standards for the latest wearable applications.

The day when our garments become sensors may not be far off: scientists have been working on the latest printed electronics technologies in order to come up with new forms of smart textiles. Researchers at the Holst Centre at Eindhoven University in the Netherlands, working with colleagues on the Ghent campus in Belgium, have demonstrated what they claim are the first stretchable and body conformable thin-film transistor (TFT) driven LED displays to be laminated into textiles. This paves the way for wearable displays in textiles to provide users with feedback.

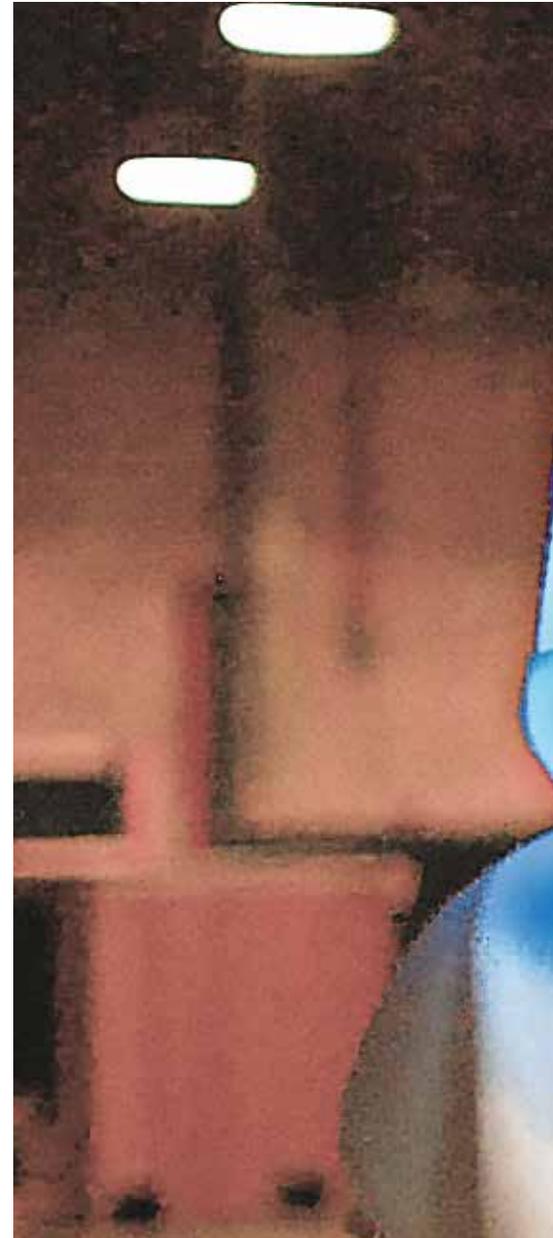
The aim is to get to the point where automated production techniques will allow manufacturers to integrate electronics and sensors directly into the yarn during the industrial process and therefore become able to mass produce the garments. According to some reports, the smart textile market is expected to reach USD 4,72 billion by 2020 (source: MarketsandMarkets). Driving factors precisely include the uptrend in wearable electronics but also the increasing demand for

sophisticated gadgets. Engineering trends include the miniaturization of electronic components, and a rapid growth of low-cost smart wireless sensor networks.

Until now, smart clothes have been more of a fad or gimmick for the trendy: some fashion designers have illuminated them with embedded LEDs and using materials which react to the environment and change colour. However, once our clothes start really talking, and have sensors and display techniques incorporated into the fabric, the possibilities for fitness monitoring and medical evaluation are limitless.

Body heat

The value of the wearable electronic technology market will rise from USD 20 billion in 2015 to USD 70 billion by 2025, according to research company IDTechEx. According to this report, healthcare is the biggest sector, comprising medical, fitness and well-being. On the whole, medical wearables are getting smaller, thanks to the evolution of nanotechnology, which involves manipulating materials on an atomic or a molecular scale to build microscopic devices. They are also getting smarter as components



such as microchips, biosensors and very small-scale batteries allow them to connect to external smart devices and transmit the information they gather.

Huge research breakthroughs are being made into new forms of medical wearable devices. In the US, the centre for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST), a university-based research hub, is looking at energy harvesting solutions, which

will enable wearable sensors to be powered by body heat and do away with cumbersome and power-hungry chargeable batteries. The technology will be applied to devices equipped with sensors which will inform asthma sufferers of pollution levels and potential dangers, for example.

Also in the US, scientists are seeking to analyze key biomarkers in a person's sweat, using a wearable patch. The aim is to detect diseases such as cystic fibrosis, for instance.

While these patches are not yet mass produced, in other fields, wearables are already being used in mind-boggling ways.

Talking cows

Upper-leg wearable devices are routinely used by farmers to monitor the heat and movement of their cows. This enables them to manage the cows' fertility levels better and ensures calves are born at optimum intervals, while maintaining the highest levels of milk production.



A hand-worn sensor transmits information about mood/emotions to the Mood Sweater collar which glows, using LEDs to display a variety of colours associated with different moods (Photo: Sensoree)



Cows wear devices which inform farmers of the best time for milking
(Photo: MooMonitor+/Dairymaster)

Enhancing safety and security

While the craze for fitness-related wearables may be waning slightly, there are still a number of new devices out there, mostly focused on ensuring the wearer's safety. A stretchable patch sensitive to UV light and equipped with sensors monitors the user's exposure to sunlight. Highly reactive dyes alter colour depending on the UV rays detected and the data collected is synced with a phone app.

An alarm embedded in attractive costume jewellery is a new way to enhance existing smart bracelets on the market. If the wearer runs into trouble, a double tap on the bracelet sends their location and an SOS message to their emergency contacts. The list is endless...

On the Tour de France, increasingly complex technology involving sensors enables TV viewers but also sport managers to track cyclists' performances in real time. Sport is an area where keeping track of essential bio data not only engages the TV audience but also provides

essential information on the athlete's performance and his or her state of fitness.

Standards pave the way

The IEC prepares the International Standards which provide the foundation for many of the advances in wearable technology. IEC Technical Committee (TC) 47: Semiconductor devices, produces International Standards for the design, use and re-use of sensors as well as their testing and their certification. The internet of things (IoT) and human body communication are two of the new application areas with which the TC is involved. The IEC 62951 series of Standards, in particular, covers the fields of flexible substrates and thin film, used in wearable patches. While IEC 62951-1 was published in April 2017, several other parts of the series are under development.

IEC TC 62: Electrical equipment in medical practice, is also one of the most important committees when it comes to medical wearable devices, for instance through the work of its

subcommittee, SC 62B: Diagnostic imaging equipment. IEC TC 100: Audio, video and multimedia systems and equipment, and IEC TC 110: Electronic display services, cover all areas relating to display technology. Printed electronics is standardized under the remit of IEC TC 119. The work of IEC TC 113: Nanotechnology for electrotechnical products and systems, comprises terminology, measurement and characterization and performance assessment of substances for certain coatings on implanted devices.

One of the most recent committees to have been set up by the IEC is TC 124: Wearable electronic devices and technologies. Its scope is to prepare Standards for applications such as patchable, implantable and even edible materials and devices as well as electronic textiles.

The increasingly all-encompassing IoT is being standardized under the umbrella of ISO/IEC JTC 1/SC 41: Internet of things and related technologies, a subcommittee of the IEC and the International Organization for Standardization (ISO) Joint Technical Committee ISO/IEC JTC 1: Information technology.

Health and safety issues are crucial to anything relating to medical applications. IECEE, the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components, offers global testing and certification based on International Standards. Its members verify and certify the safety, quality and efficiency of all types of medical equipment, including the newest generations of wearable devices. IECQ, the IEC Quality Assessment System for Electronic Components, ensures that the components used in these new technologies are tested and certified.

Energy efficiency to recover power for the future

IEC work helps tap the biggest pool of available energy

By Morand Fachot

Energy efficiency (EE) is the most important and easily available source of energy; it can be collected along the entire energy chain, from generation, transmission and storage to final use in industry, homes or transportation. IEC standardization and conformity assessment (CA) work are central to electrical EE at all levels.

Dual approach

There are essentially two ways of improving EE

- Selecting technologies that are more efficient in converting primary energy (fossil or nuclear fuels, biomass and renewable energy sources) into useful power, including electricity. This aspect is often not taken into account when considering energy efficiency.
- Achieving the same outcome by using less energy.

Improving EE means also being able to measure the energy consumption of a device, system or process. This is achieved through data collection and analysis as well as by testing and verification. A well-



Convection/infrared electroheating oven for automotive dashboards (Photo: Infrared Heating Technologies)

defined set of criteria and metrics is indispensable for achieving meaningful and comparable results. For electrotechnology products, these are often incorporated in IEC International Standards.

Energy generation, storage, transmission, distribution

Converting primary energy into electrical energy can range from a very

efficient process to others that are more wasteful.

The most efficient source of electricity is hydropower. Modern hydraulic turbines can convert 90% or more of energy from water into electricity.

By contrast, burning fossil fuels to produce electricity can be very wasteful. In older thermal plants, converting fossil fuels (coal in

particular) into electricity can waste 2/3 of the primary source of energy. Thermal power plant can be made more efficient through combined heat power (CHP) use.

Renewable energy sources include, in addition to traditional hydropower (which makes up some 85% of the total from renewables), geothermal, wind, solar (photovoltaic [PV] and thermal), marine energy conversion (wave, current, tidal). Owing to the intermittent nature of some renewables, hydropower, acting as storage available instantly, plays an important role in balancing production and ensuring grid stability. The following IEC technical committees (TCs) develop International Standards for power generation systems:

- TC 4: Hydraulic turbines
- TC 5: Steam turbines (used in geothermal, electricity generation from fossil and nuclear fuels, solar thermal electric plants and CHP)
- TC 82: Solar photovoltaic (PV) energy systems
- TC 88: Wind energy generation systems
- TC 114: Marine energy – Wave, tidal and other water current converters
- TC 117: Solar thermal electric plants

Storing electricity is important for energy efficiency projects by optimizing output from intermittent sources. In addition to hydropower, secondary (rechargeable) batteries are the main source of electrical energy storage (EES). Standards for these are developed by:

- TC 21: Secondary cells and batteries, for all types of batteries used in EES including stationary (lead-acid, lithium-ion and NiCad/NiMH) batteries and flow batteries
- TC 120: Electrical energy storage (EES) Systems, which develops International Standards in the field of grid integrated EES Systems, focusing on system aspects rather than energy storage devices

Transmission and distribution are other areas where better efficiency can be achieved. IEC International Standards provide the performance and test requirements that help assess the efficiency of all types of cables (developed by TC 20), overhead lines (TC 11) and overhead conductors (TC 7). They help calculate losses and provide important parameters for cable design and installation. Important new technologies such as high voltage DC (TC 115) and ultra high voltage AC (TC 122) transmissions are made safe through IEC work. This highly sophisticated technology can help reduce transmission losses over long distances by up to 30%.

Transformers are another area where IEC work helps reduce power losses and, indirectly, carbon emissions. TC 14 develops Standards in the field of power transformers, tap-changers and reactors for use in power generation, transmission and distribution. It has published IEC TS 60076-20:2017, which proposes two methods of defining an energy efficiency index and introduces three methods of evaluating the energy performance of a transformer.

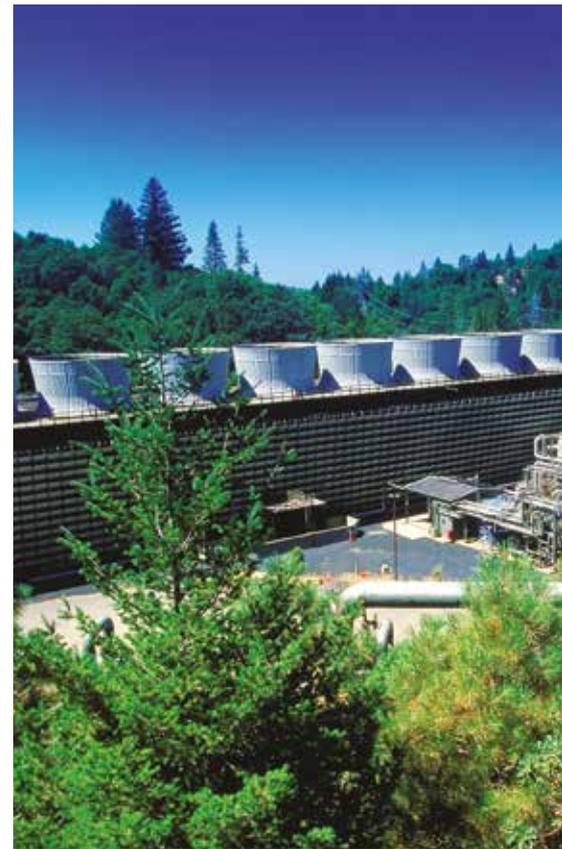
So-called microgrids and off-grid rural electrification help reduce transmission losses by avoiding the need to transmit electricity over long distances.

Electricity is used for countless applications in industry as well as in buildings and in the domestic environment.

Industry as prime consumer...

Industry accounts for 40% of global electricity consumption, of which around 70% is consumed by electrical motors that convert electricity into mechanical energy for machines, and also by pumps, fans, compressors, etc.

Over 90% of electrical motors cannot adjust their power consumption to meet fluctuations in power demand,



Geothermal energy plant at The Geysers near Santa Rosa,

thus wasting precious energy. Improved motor control and motor efficiency mean greater overall production efficiency. Changing to electric motors with variable-speed drives can reduce energy consumption by up to 50%. The annual energy cost of running a motor is usually many times greater than its initial purchase price and energy savings quickly amortize the initial investment: the new energy-efficient motor basically pays for itself.

TC 2: Rotating machinery, has developed International Standards that rate electric motors according to their efficiency classes and IECEE, the IEC System for Conformity Assessment Schemes for Electrotechnical Equipment and Components, has put in place the IECEE Global Motor Energy Efficiency Programme (GMEE).

In addition to motors, which drive the large majority of production processes, several other technology areas offer a good potential for increased energy efficiency.



California, USA (Photo: NREL)

Around 20% of electricity (up to 40% in some industries) is used in heating processes. These are employed widely across many sectors from food processing and automotive applications to smelting. Electroheating offers many benefits over processes that rely on the combustion of fossil fuels. Higher efficiency is just one of them; cleaner air, higher temperatures and better process control are among the others. The optimum energy efficiency of gas furnaces ranges from 40% to 80%, that of an electric furnace can reach 95%.

International Standards for electroheating are developed by TC 27.

Automated systems for smart manufacturing will pave the way for more energy efficient processes. They cover the whole life cycle of a product from idea to order, construction and development, delivery and recycling, including all related services. TC 65 develops International Standards that

address the safety and efficiency of equipment and processes and the regulatory compliance and energy consumption, as well as the many protocols and methods that support the full range of communication, monitoring, control, safety and cyber security technologies in the area of automation.

...but don't forget buildings

In addition to industry, buildings – for commercial and residential use – are heavy energy users. They account for about 40% of primary energy consumption in many countries. This energy is used for lighting, heating, ventilation and air conditioning (HVAC) systems, as well as for powering elevators, escalators, machinery and appliances.

Building automation and control can improve the energy efficiency of buildings significantly. They include a wide variety of technologies that are connected wirelessly, including light detectors, timers, temperature, motion, humidity and many other sensor systems, as well as programmable logic controllers. Building automation can help optimize device use by switching devices off entirely or by reducing their use to the minimum.

TC 8 focuses on overall systems aspects of electricity supply. TC 57 deals with communications between equipment and electricity systems. TC 47 develops Standards for sensors and similar devices.

Heating and cooling require a significant amount of energy. Heat pumps represent one of the most efficient means of heating or cooling a building. They require a minimum amount of electricity to function and work on the principle of transferring heat from water, air, soil or other sources to provide hot water or air conditioning. TC 61 develops Standards that provide specific requirements for heat pumps, air conditioners and dehumidifiers.

Elevators and escalators are energy-hungry systems, they account for up to 10% of energy use in buildings. Innovative motors and regenerative braking systems that recuperate energy help cut elevator power consumption in half. Escalators can be made more efficient by mounting sensors that turn them off when they are not needed or that activate soft start systems when the number of people carried is low.

Electric lighting consumes a significant amount of electricity, estimated at nearly 20% of total electricity production. The choice of technology makes a big difference in terms of electrical EE. Incandescent bulbs waste about 95% of the energy they use in the form of heat. Compact fluorescent lamps are 80% more efficient than incandescent bulbs, but lights based on light-emitting diode (LED) are up to 95% efficient converting electricity into light. TC 34 prepares most International Standards for safe and efficient lighting, including performance requirements, specifications, testing and measuring methods for all types of lamps and their auxiliaries. Other IEC TCs, such as TC 23 and TC 47, develop Standards that apply to electronically-activated switches and sensors.

Consumer goods are getting ever more energy efficient too!

TC 59 develops International Standards that address the energy efficiency characteristics of household appliances such as dishwashers, laundry appliances, cooking, fridge/freezers and many more. Among other things, these Standards are the basis for measuring and testing performance and power consumption, including in standby mode.

TC 100 provides standard measurement methods for the power consumption and energy efficiency of audio, video and multimedia systems, as well as other equipment connected to the power mains. These methods also cover applications for home energy management applications.



Tram and Solaris electric bus (Photo: Solaris)

Energy efficiency claims made by manufacturers need to be verified independently. Such verification is done by independent laboratories, many of which also participate in IECEE.

Transportation now embarked on major electrification drive...

Internal combustion engines (ICEs), still the main mode of propulsion for road vehicles, are getting more and more fuel-efficient through the increased use of electronics systems. However, the most significant energy savings will come from making a move from ICEs to electric drivetrains or fuel-cell vehicles to power motors. The work of TC 21, TC 23, TC 69 and TC 105 supports the introduction of electric, hybrid or fuel-cell vehicles, covering the full range of relevant electric and electronic technologies, including batteries and charging infrastructure. The electrification of public transport is well advanced in urban environments with the

introduction of electric buses in addition to existing tramway and trolleybus lines. Rail transport is also being increasingly electrified in many countries. TC 9 is tasked with the standardization of energy management systems in trains, metros, trams and similar transport applications. Electric vehicles are also found in many industrial applications, such as in warehouses (forklifts) and airports (aircraft tow trucks). All of this helps accelerate the transition to cleaner, more EE transport systems.

For shipping, TC 18, TC 20 and TC 23 work on systems and technologies aimed at increasing EE in shipping. Their work supports the introduction of hybrid and full electrical propulsion systems, especially for short journeys, for example in harbours.

New energy efficiency technologies

There is a rapidly increasing range of applications, including in the power

sector, that use energy harvesting. This entails the process of collecting low levels of energy from sources such as ambient or waste heat, solar, thermal or kinetic energy and converting it into electrical energy. This trend is driven by sensors and wireless communication devices which aim increasingly to run independently from an external power source. Most kinetic-based energy harvesting systems depend on piezoelectric transducers. International Standards for these are developed by TC 49.

Low-voltage direct current (LVDC) – a solution gathering pace

LEDs, cell and fixed phones, IT or multimedia equipment are able to use DC. Solar PV generates DC and yet – even in rural off-grid settings – this energy is transformed into alternating current. This results in unnecessary efficiency losses.

LVDC is a low cost, simple but high-level technology that promises to bring energy to the millions who have none. It will help reduce conversion losses and eliminate the need to build many power transformers. LVDC will also make it easier to connect renewable energy.

The IEC is leading efforts to make this technology safe for use in rural electrification but also in data centres, hospitals, office buildings and other domains that use a lot of energy and would benefit from no losses in energy conversion. It set up a Standardization Evaluation Group (SEG 4) to evaluate the status of standardization in the field of LVDC applications and products and to recommend to the Standardization Management Board (SMB) the architecture of any future standardization work programme that the IEC may undertake.

Printed electronics gathering pace

Printed electronics has moved rapidly from lab to manufacturing processes in recent years

By Morand Fachot

Printed electronics is a relatively new technology, but it has already proven a disruptive, yet creative process that allows the production of new products and components, low-cost electronic devices, which open the way to a range of new applications. It has started transforming the electronics industry and many other domains by being included in different manufacturing processes. This new technology led to the creation, in 2011, of IEC Technical Committee (TC) 119: Printed electronics.

Designation may be misleading

The production of printed circuit boards (PCBs), used in computers, TV or radio sets and many other electronic products and parts, launched decades ago, may give the impression that “printed electronics” (PE) has been around for a long time, actually PE is a “new kid on the block”. It consists in the creation of electronic devices and components using various printing methods, equipment and material such as special substrates, conductive and dielectric inks. PE makes possible the production of a wide variety of products increasingly found everywhere.



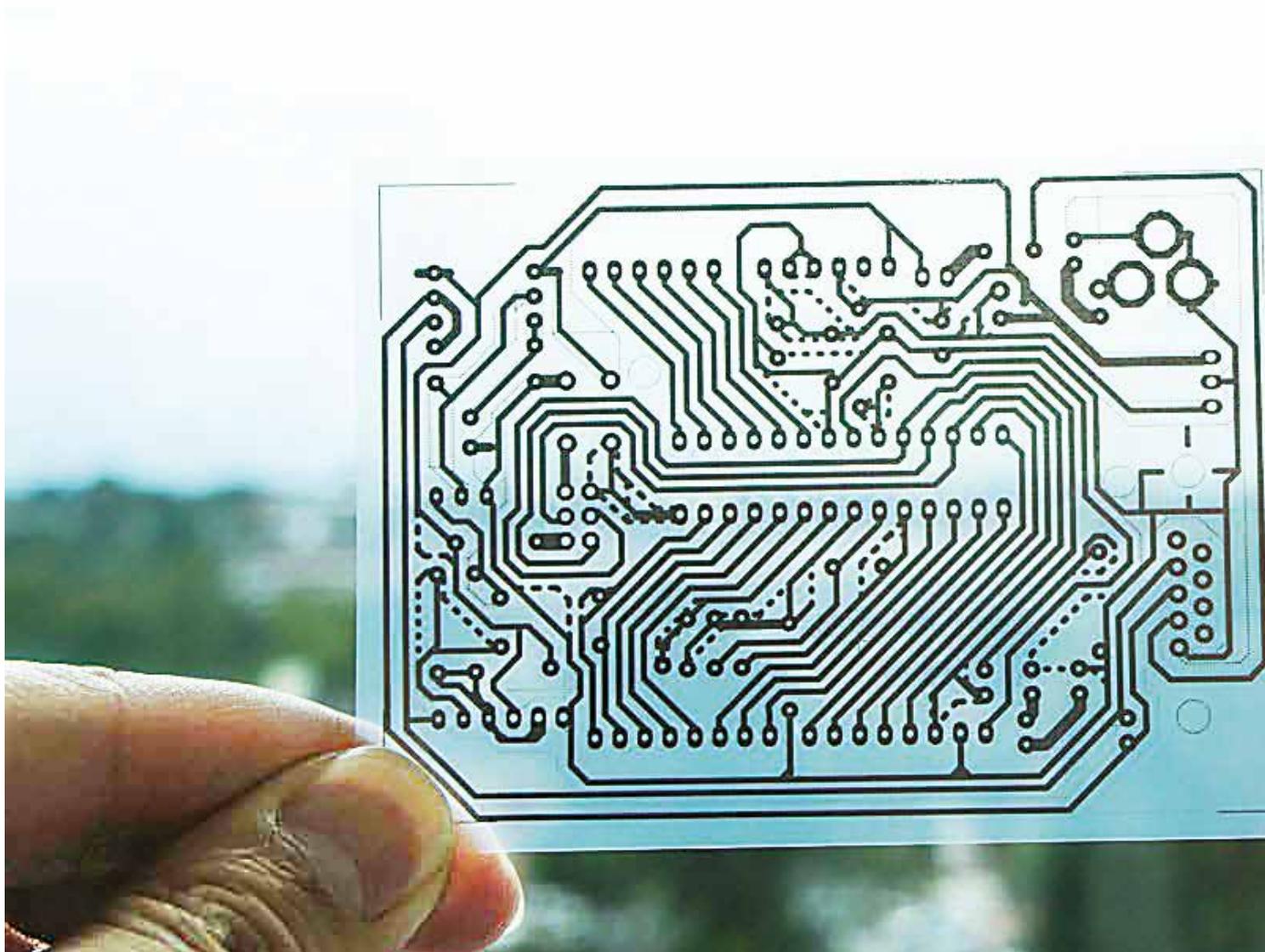
An electronic tattoo picks up sounds made by the heart, gastrointestinal tract or muscles for example (Photo: Jeong Lab, University of Colorado Boulder)

It has other advantages, such as a much lower production costs than conventional electronics and it can be applied to flexible or rigid supports (or substrates).

Countless products and applications

PE is already widely used in the production of radio frequency identification (RFID) tags placed on

product packaging to protect against shoplifting, to help manage and track stocks, check shelf life, or to identify items, including luggage, during transport. RFID can also be built in contactless payment devices and even implanted into people. Some 14 billion RFID tags will be sold in 2017, up 40% on 2016, a market worth USD 11,2 billion, according to emerging technology research company IDTechEx.



A single-sided wiring pattern for an Arduino micro controller was printed on a transparent sheet of coated PET film (Photo: Georgia Institute of Technology)

PE is also used in the production of sensors, flexible electronic circuits which are widespread in products where space constraints are significant, such as in small consumer electronics devices, e.g. digital cameras, mobile phones.

It is now being introduced into the further development of photovoltaic (PV) devices and of wearable smart devices (WSDs) for use in a wide range of domains from leisure to wellness, health and medicine.

Furthermore, new printed electronics applications are emerging, opening up possibilities not envisaged before. One such application is in the domain

of printed batteries. More than three years ago, US scientists printed a lithium-ion battery the size of a grain of sand that could one day power tiny medical implants as well as other microelectronic devices.

IDTechEx describes PE as “one of the fastest growing technologies in the world. It is of vital interest to industries as diverse as consumer goods, healthcare, mobility, electronics, media and architecture.”

From research to industrial design and marketable products

New technologies in the PE domain are emerging all the time and the

market is fast expanding. IDTechEx estimates that the total market for PE and flexible PE worth some USD 7,6 billion in 2017 will exceed USD 46 billion in 2027.

PE is found in more and more mass-produced items, in particular in the automotive, consumer electronics and pharmaceutical industries.

The printed electronics industry currently covers five main areas:

- Lighting, including both organic LED (OLED) and electroluminescent (EL) products
- Organic photovoltaics (PV)



- Flexible displays
- Electronics and components, including RFID, memories, sensors, batteries and other components
- Integrated smart systems (ISS) that include smart objects, sensors like microelectromechanical system (MEMS) and smart textiles

These areas that see widespread use of PE are already covered by several IEC TCs. This led TC 119 to embark upon a series of liaisons with other TCs and external organizations.

A good example of this is the liaison with IEC TC 47: Semiconductor

devices, since many of the resultant products will be hybrid devices, with both printed and conventional silicon-based components being integrated into one unit. Similarly, the liaison with IEC TC 110: Electronic display devices, makes sense as components for electronic displays are already being produced by printing, and printable materials for OLED displays are commercially available. Most OLED displays are currently produced on rigid substrates, but flexible substrates will be used more widely in future OLED displays.

PE support for PV

Traditional silicon-based PV needs some physical protection from the weather when mounted on the outside of a building. This is most commonly achieved by assembling the active layers between two sheets of rigid material, which act as a physical barrier, preventing damage to the electrically-active assemblies.

As PV move away from rigid to flexible material, they can be printed on flexible substrates, which need to be protected by a multilayer barrier film glued or deposited onto the printed PV layer to be protected. This allows new design freedoms and it is anticipated that this will become an increasingly important market sector.

Sensors everywhere

Sensors are found in a growing number of devices and applications and demand is set to explode with the expansion of the devices needed by the internet of things (IoT) in home (smart homes) and wider environments (smart cities and industry).

PE offers countless and unparalleled opportunities to produce new types

of sensors through miniaturization, reduction in power consumption and new form factors (flexibility). These sensors can be deployed in IoT, wearable smart devices (WSDs), consumer electronics and robotic application. Printed and flexible sensors currently represent a market worth some USD 6,1 billion. The market for environmental (air quality sensors) gas sensors (fixed outdoor/portable/indoor) will grow exponentially from less than USD 500 million in 2017 to some USD 3 billion in 2027, according to IDTechEx research.

WSDs major PE driver and beneficiary

WSDs are a category of products of high interest to PE. This is a field that provides a very good illustration of a systems integration challenge that requires input from a substantial number of horizontal technologies.

WSDs can be categorized in a variety of classes, such as “in body”, “on body” and “near body”. Of particular interest to the field of printed electronics are flexible electronic components. One example of these would be electronics printed onto textile substrates that are flexible and/or stretchable, giving rise to flexible displays integrated into garments. These could then be integrated into conformable wearable devices that could fit into everyday life in a variety of implementations.

The IEC Standardization Management Board (SMB) has recognized the potential of WSDs and the wide number of IEC TCs that have stakes in the applicable technologies. It started a Strategy Group, SG 10: Wearable smart devices, tasked with reporting back on strategy options for standardization. Following the SG 10 report the SMB created



RFID tags can be placed on product packaging to manage and track stocks, protect from shoplifting or identify items such as luggage (Photo: Metalcraft)

TC 124: Wearable electronic devices and technologies. This TC is set to liaise with a number of IEC TCs including, among others, TC 47, TC 62: Electrical equipment in medical practice, TC 100: Audio, video and multimedia systems and equipment, TC 119, TC 77: Electromagnetic compatibility, TC 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure, TC 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology, and TC 111: Environmental standardization for electrical and electronic products and systems.

The health and safety aspect is of particular importance as the products will by definition be in close proximity to a human or animal. The substrates and functional materials employed must therefore of necessity be non-toxic and bio-compatible. As smart

devices, they are likely to include some mode of wireless connection, so electromagnetic compatibility and safety are also important. This highlights some of the complex issues around systems integration, emphasizing the need for involvement of the multiple disciplines found in IEC TCs.

3D printing of electronic products

3D printing of electronic products shares many technologies with PE. Many electronic products are now printed, even making possible the fast prototyping of entire PCBs using inkjet technology, and nanoparticle inks. Advanced PCBs can be printed quickly and tested by manufacturers after design without having to call on third party companies to produce prototypes.

It is now possible also to add electronics on plastics to produce

flexible and adaptable products using an additive metallization process for plastics and composite materials, which adds value on composite materials, especially in the automotive area.

Bright prospect on the horizon

TC 119 Chair Alan Hodgson notes that PE is fast closing the gap between lab and fab (laboratory project to industrial fabrication), PE is now ready for manufacture and integration with other technologies within the IEC family.

PE technologies will make it possible to produce many more products, more cheaply and more reliably in coming decades as the range of PE expands. Many of these products will rely on IEC International Standards developed by IEC TCs that will work and liaise closely with TC 119.

Dealing with natural and industrial disasters

IEC Standards are key to help prevent and/or mitigate the impact of many disasters

By Morand Fachot

Natural and industrial or accidental disasters can take many forms and have devastating human and material consequences. Some may be prevented or their impact mitigated through forecast, others not. Rescuing victims and repairing damage are essential for a return to normal life. Standardization work by a number of IEC technical committees (TCs) and subcommittees (SCs) may help warn of impending disasters as well as aid in assessing, repairing and mitigating their consequences.

Natural, engineering or accidental disasters, often a matter of scale

Natural disasters can be considerably deadlier and more destructive than their engineering or industrial equivalents. They may result from weather-related causes (hurricanes, cyclones, storms, floods, heatwaves, blizzards, etc.), or movements at the surface of the earth that may provoke earthquakes, volcanic eruptions or tsunamis.

Natural disasters may result in industrial disasters. This was the case when heavy rainfall following a typhoon caused the collapse of

the Banqiao dam in China in 1975, resulting in the immediate death of more than 25 000 and, indirectly, of 250 000 later.

This was the case also in March 2011, when an earthquake in the Pacific Ocean some 70 km east of Japan

provoked a tsunami that disabled the power supply and cooling systems of the Fukushima Daiichi nuclear power plant, resulting in a partial meltdown of some units of the plant. No radiation casualties occurred at the time, but the government ordered the evacuation of over 100 000 people



VR training for a biological agent attack (Photo: Randy Montoya)

living within a 20-30 km radius of the plant.

A major industrial accident, the April 1986 Chernobyl nuclear power plant disaster in northern Ukraine was the result of flawed reactor design combined with a number of errors from operators. Some 40 staff and emergency workers died within a few months from radiation-related illnesses, and some 7 000 cases of thyroid cancer in people under 18 at the time of the accident were reported.

Getting advance warning and assessing risks after disaster

Getting some advance warning of natural disasters, such as earthquakes and tsunamis, using electronic equipment may be possible in some cases. This includes:

- laser equipment emitting beams that can detect tectonic plates movements. International Standards for equipment (including systems) incorporating lasers are developed by IEC TC 76: Optical radiation safety and laser equipment
- seismometers which pick up, measure and record vibrations in the Earth's crust through electronic sensors, including accelerometers, amplifiers and even lasers and interferometers in more modern optically-based devices. International Standards for a variety of sensors used in seismometers (and other devices) are prepared by IEC SC 47E: Discrete semiconductor devices. International Standards for interferometers used for the calibration of optical frequency measurement instruments, are prepared by IEC TC 86: Fibre optics

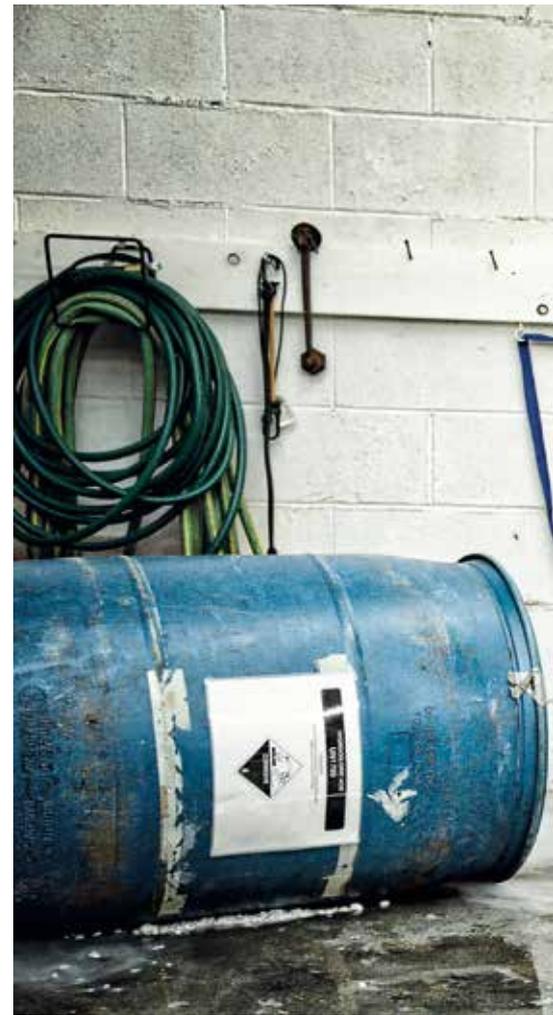
- gas detectors which pick up increased levels of radon gas emissions escaping from cracks in the Earth's crust. International Standards for gas detectors are developed by IEC TC 31: Equipment for explosive atmospheres

To help prevent nuclear accidents or to assess health risks in the aftermath of an accident, work by IEC TC 45: Nuclear instrumentation, and its SCs is essential. They develop International Standards for a wide range of instrumentation used in the nuclear industry, including control and electrical systems, and of the radiation protection instrumentation that is useful for controlling radiation levels in nuclear power installations, in case of accident and to prevent the smuggling of radioactive material.

IEC TC 31 and its SCs develop and maintain International Standards "relating to equipment for use where there is a hazard due to the possible presence of explosive atmospheres of gases, vapours, mists or combustible dusts." The IEC also set up IECEx, the System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres. IEC TC 31 Standards and IECEx Certificates are internationally recognized and widely adopted by many industries. In addition, IECEx has been endorsed by the United Nations, through the UN Economic Commission for Europe (UNECE), as the recommended model for regulating the safety of equipment and persons working in areas where the potential for an explosive atmosphere may exist.

Prevention and mitigation of power outages, and recovery

Natural disasters may result in large-scale power outages. Without

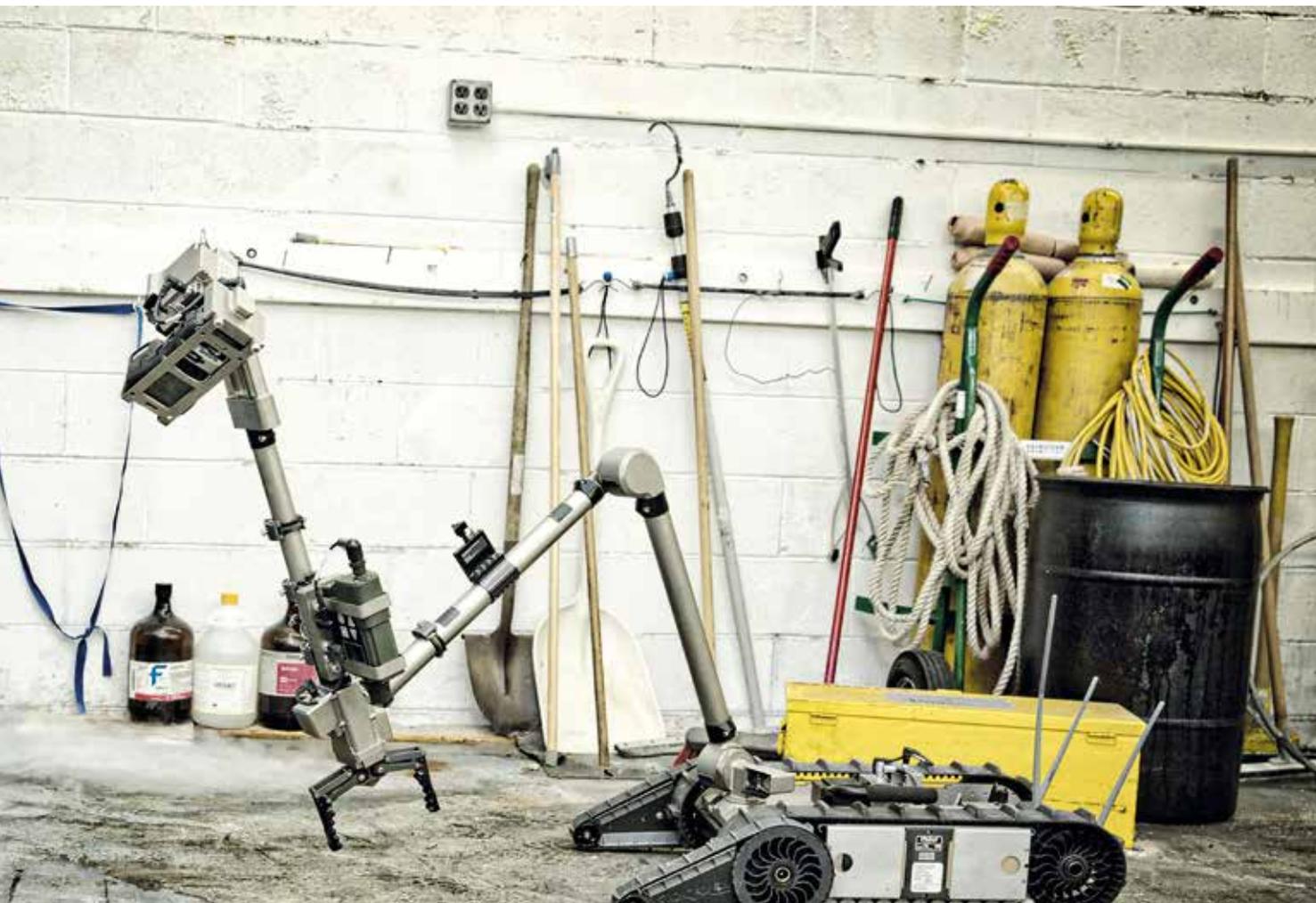


Endeavor Robotics 510 Packbots are deployed in emergency nuclear power plant (Photo: Endeavor Robotics)

electricity nothing works: fresh water supply, waste water treatment, mass transportation and communication systems are interrupted. The operation of hospitals and emergency services is disrupted, homes and businesses are affected.

This was the case following the 26 December 2004 tsunami in South East Asia, the January 2010 earthquake in Haiti or hurricane Sandy, which hit the North Eastern coast of the US in late October 2012.

Power grids in some countries are more affected than in others by natural disasters. This has much to do with the nature and structure of grids, not just the frequency of natural disasters.



situations when direct human intervention is dangerous or impossible, such as after industrial or nuclear accidents. These robots were used at the Fukushima

For instance, Japan, which is regularly subjected to earthquakes and extreme weather situations, has one of the shortest outage times in the world.

Even before the Fukushima disaster, the country had already invested in microgrid technology which helped it better deal with the huge challenges it faced in the wake of the earthquake and resulting tsunami. Microgrids, and smart grids are seen as useful solutions that help prevent serious power outages.

The IEC White Paper *Microgrids for disaster preparedness and recovery* provides examples of the benefits of microgrids to mitigate the impact of disasters on power supply.

Standards are crucial in helping new disaster-resilient technologies become widespread. The IEC is doing pioneering work in the area of smart electricity, by adopting a systems-based approach, with its Systems Committee (SyC) Smart Cities and SyC Smart Energy.

Rescue efforts go high-tech

Disaster relief needs being quick and efficient. For this it relies increasingly on sophisticated high-tech systems. These include various types of robots, virtual reality (VR) tools and so-called exoskeletons that allow limb movement with greater strength and endurance, providing wearers with the capability of lifting heavy loads.

Robots to the rescue

Rapid advances in technology are revolutionizing the roles of aerial, terrestrial and maritime robotic systems in disaster relief, search and rescue (SAR) and salvage operations.

Robots and drones can be deployed quickly in areas deemed too unsafe for humans and are used to guide rescuers, collect data, deliver essential supplies or provide communication services.

Drones and robots have been used to survey damage after disasters such as the Fukushima Daiichi nuclear power plant accident in Japan in 2011 and the earthquakes in Haiti (2010) and

Nepal (2015). Up to now, more than 50 deployments of disaster robots have been documented throughout the world, according to the Texas-based Center for Robot-Assisted Search & Rescue (CRASAR).

Head of CRASAR Robin Murphy says that robots will be ever more used in disaster situations: “the impact of earthquakes, hurricanes, flooding [...] is increasing, so the need for robots for all phases of a disaster, from prevention to response and recovery, will increase as well”.

Drones, also known as unmanned aerial vehicles (UAVs), can be used to detect and enter damaged buildings, assisting rescue robots and responders on the ground by speeding up the search for survivors through prioritizing which areas to search first. Japan and the US lead the world in the development of rescue and disaster relief robots. Teams from both countries collaborated in recovery efforts after an earthquake and tsunami hit Japan in March 2011, causing the meltdown at the Fukushima nuclear power plant.

Given that 80% of the world’s population lives near water, maritime robotic vehicles can also play an important role in disaster relief by inspecting critical underwater infrastructure, mapping damage and identifying sources of pollution to harbours and fishing areas. Maritime robots helped to reopen ports and shipping channels in both Japan and Haiti after the major earthquakes of 2011 and 2010 respectively.

Several IEC TCs and SCs cooperate on the development of International Standards for the broad range of electromechanical systems, equipment and applications used in rescue robots. In addition to IEC TC 47: Semiconductor devices, and

IEC SC 47F: Microelectromechanical systems, mentioned above, other IEC TCs involved in standardization work for specific areas affecting rescue and disaster relief robots include IEC TC 44: Safety of machinery – Electrotechnical aspects; IEC TC 2: Rotating machinery; IEC TC 17: Switchgear and controlgear; and IEC TC 22: Power electronic systems and equipment.

Training rescuers and first responders efficiently

Training search and rescue (SAR) personnel for disaster situations they have never experienced is a time-consuming and complex task that can now call on new tools, such as virtual reality (VR).

State-of-the-art VR training programmes immerse users into a seemingly real disaster scenario. Background noise, visual and auditory cues create unique settings and incidents which require users to respond to the specific situation. This hands-on approach is far more effective than learning check lists for a number of possible disasters. The more familiar you are with a scenario, the more likely it is that you will be able to perform effectively.

There are many advantages to using VR training:

- Safe – trainees can practise real-life skills in a safe environment
- Efficient – individuals and large groups can train alone or together
- Comprehensive – predesigned modules cover all types of situations
- Cost effective – VR training doesn’t require special environments to be built or people to be transported, can be used multiple times and may be offered for free to

emergency services

- Tailored – response agencies will be able to tailor open source platforms to suit their requirements, infrastructure and available resources
- Scalable – agencies can train alone or together for a coordinated response with other emergency services

VR can also be used to train staff in case of disease outbreaks. A charity working with the World Health Organization decided to use VR to update its training during the 2013 and 2016 Ebola virus outbreak in West Africa. The Ebola Training Project VR medical training simulation is a serious game based on a 3D model of the space and structures of an actual Ebola hospital. With the addition of sound effects and unique aspects of the working environment, users have the impression they are in a treatment unit in the field. They experience giving medical care to patients through fogged-over glasses – one of the real life effects of sweating in required full-body protective clothing. Trainees also wear this clothing to get a better understanding of the limitations on movement it provides.

VR is also used to train fire, rescue and emergency services personnel in many countries.

Behind the VR scenes, software drives components such as displays, sensors, images, maps and tracking technology, which link to the hardware (headsets or helmets). A number of IEC technical committees (TCs) and their subcommittees (SCs) produce International Standards and have testing systems which help ensure the reliability, safety, efficiency, interoperability and quality of the components within this technology.

ISO/IEC JTC 1, the Joint Technical Committee of IEC and the International

Organization for Standardization (ISO) covers standardization for information technology (IT).

ISO/IEC JTC 1/SC 24 works on interfaces for IT-based applications relating to computer graphics and virtual reality, image processing, environmental data representation,

support for mixed and augmented reality, and interaction with, and visual presentation of, information.

Sensors and microelectromechanical systems are vital to VR technology.

The work of IEC TC 47 and IEC SC 47F ensure they work reliably

and efficiently. IEC TC 100 produces Standards which contribute to the quality and performance of audio, video and multimedia systems and equipment and their interoperability with other systems and equipment.

Helping with heavy lifting

An exoskeleton is a wearable mechanical outfit that is powered by a system of electric motors, pneumatics, levers, hydraulics, batteries or a number of technologies that allow limb movement with greater strength and endurance. It makes it possible for wearers to lift heavy loads without injuring themselves.

Following the 2011 earthquake and tsunami which led to the Fukushima nuclear power plant disaster, a Japanese R&D company for medical, rehabilitation and disaster rescue support, has developed a hybrid assistive limb (HAL) for disaster recovery, an exoskeleton suit, designed to aid users working under harsh conditions. This particular model claims to reduce radiation exposure by 50%, and includes a cooling system to prevent heatstroke. Equipped with sensors, it monitors heart rates and vital signs in real-time, while most of the suit's weight is carried by the skeleton's mechanical legs.

Disaster relief is often seen as concerning primarily rescuing and helping the people affected, and the restoration of essential services, such as power or water supplies. Actually a number of systems and services that rely on IEC Standards and Conformity Assessment Systems, and the introduction of systems aimed at ensuring decentralized energy generation and distribution could help prepare for the worst consequences of natural or man-made disasters and mitigate their impact on people and infrastructure.



A Japanese company has developed an exoskeleton suit that can aid rescue workers in harsh conditions (Photo: AvaxNews)

Improving safety and reliability in process industry plants

Development of safety and reliability programmes for crucial plants

By Ahmad Hosni* & Morand Fachot

Ahmad Hosni, MSc, a Functional Safety Senior Engineer, Certified Functional Safety Expert/Professional and Certified Fire Protection Specialist, has just published a book on process safety and reliability programmes for process industry plants. *e-tech* publishes here a summary of the main findings of his book.

Following up on previous work and experience

Hosni, contributed an article for *e-tech* on *Asset integrity and functional safety* in 2015. The article drew lessons from the February 2015 condensate leak incident on the Gudrun North Sea offshore platform operated by Norway's Statoil company.

Hosni shared with *e-tech* some of the findings of the book he recently published. This book focuses on process safety and reliability programme for the process industry plants (chemical, petrochemical, oil, gas, power generation, mining and nuclear power plants).

Developing such a programme faces a lot of challenges, Hosni says.

This leads to the spread of common imperfections and even mistakes in

such programmes. In addition, the availability of too many engineering, operation and maintenance Standards and practices (like IEC 61511:2017, *Functional safety – Safety instrumented systems for the process industry sector*, American Petroleum Institute (API) 14C, *Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms*, etc.) that were not developed to be aligned, contributed to inconsistency in many of the programmes developed.

The relatively new approach in IEC 61511 and in IEC 61513:2011, *Nuclear power plants – Instrumentation and control important to safety – General requirements for systems*, did not introduce new findings but rather organized the risk-based design approach whose basics have already been known from before and required by some regulations, Hosni says.

The Standards introduced new terms and guidance on how to achieve the design and perform maintenance in a systematic and consistent way. The new terms introduced are like

“functional safety”, which, in IEC 61511 does not only include safety-instrumented systems but also other protection layers (like pressure relief valves).

IEC 61511 and IEC 61513 a possible answer for most safety barriers

Can the standardization developed in IEC 61511 and IEC 61513 be applied to all safety barriers? The answer, says Hosni, is yes for most barriers especially those that aim at preventing fire, explosion, flammable and toxic releases. The benefit of this is significant improvement in safety and cost savings estimated at some 10% of capital expenditure and 30% of operational expenditure per plant. The real question is: How to design and operate the plant that way in a fully-integrated and consistent manner?

Process safety, reliability programmes, and challenges explored

Hosni's book, *“Development of a process safety and reliability program for the process industry plants”* discusses the elements of process safety and reliability programmes for the process industry plants (chemical, petrochemical, oil, gas, power

generation, mining and nuclear power plants). Moreover, it discusses the common imperfections and challenges that such programmes have in plants built until now. Furthermore, it recommends better practices to be followed in developing these programmes and each element they include. It also provides insights on cost and its balance with safety and reliability especially since, when Hosni started writing this book, oil prices dropped significantly, something that happened also more than once over the history of the oil industry.

As described in the standardization process presented in IEC 61511 and IEC 61513, plant design until decommissioning is an interlinked process.

Therefore, all activities need to be connected together and consistent and this while avoiding redundancy and inconsistencies.

This implies restructuring engineering teams to achieve consistency, safety and save cost. It also implies aligning safety and reliability studies like quantitative risk analysis (QRA), hazard and operability study (Hazop), consequence modelling, layer of protection analysis (LOPA), safety integrity level (SIL) assessment, hazardous area classification, fugitive emissions, valve tightness and the design of safeguards like alarms, trips, relief valves, protective barriers and dikes, etc. and the inspection and maintenance programmes.

Hosni's book gives a comprehensive review of works published previously and more recently, followed by an analysis of a case study showing the typical weakness points common in many plants design and maintenance. It further explains how to carry out the restructuring and configuration within the design and engineering phase, as well as the operational phase of the plant till its decommissioning.

Several common design cases are also discussed with recommendations on how to organize the design in the safest and most cost-effective manner.

All the information contained in this book should be of interest to engineers and other experts involved in the design, operation and management of process industry plants. It is also worth noting that the book is now an IChemE Global Award Finalist.

Reference: Ahmad Hosni (2017), *Development of a process safety and reliability program for the process industry plants*

*Ahmad Hosni, MSc, is a Functional Safety Senior Engineer (FS Eng), Certified Functional Safety Expert/ Professional (CFSE/CFSP) with TÜV SÜD/CFSE Board CFSP, TÜV Rheinland, and a National Fire Protection Association/Certified Fire Protection Specialist (NFPA/CFPS)



Statoil's Gudrun offshore platform experienced a condensate leak in February 2015 (Photo: Eli Skjæveland Tengesdal - Statoil)

Air transport required to clean its acts

Air transport gets more energy efficient as it comes under scrutiny for its environmental impact

By Morand Fachot

Transportation is a major source of emissions of greenhouse gases (GHG); air transport is a contributor and efforts have been under way to cut emissions from the sector for many years. These are not limited to cutting down emissions from aircraft alone, but include also limiting the environmental impact from airports, and all associated support services and installations. IEC standardization work contributes significantly to this development.

Leaner aircraft are good but not enough

Air transport is the world's second largest consumer of fuel for personal mobility (11% of the total modes of transport) after light-duty road vehicles (44%). However, it uses less fuel than modes of transport for freight, such as trucks (23%) or marine vessels (12%), according to estimates from the US Information Energy Administration (EIA).

Fuel consumption per seat and per km of passenger aircraft has improved constantly and significantly, with the latest generation of passenger aircraft



Mototok remote-controlled electric tow truck in operation (Photo: Mototok)

using about a quarter of the fuel per seat and per kilometre compared to the first generation, thanks to better overall design and more fuel-efficient engines.

However, according to the International Civil Aviation Organization (ICAO), aviation still contribute to approximately 2% of the global GHG emissions, and the amount of CO₂

emissions from aviation is expected to grow around 3-4 percent per year. This overall increase results from the robust growth of the sector in general, even as aircraft become more fuel efficient.

Getting down to earth

One area that can contribute significantly to mitigate the negative



environmental impact of air transport is to be found on the ground.

It concerns the operation of airports and all associated services ranging

from aircraft ground operations and services, to airport installations, to the management of the flow of passengers and freight to and from the airport.

ICAO and other industry organizations, such as the Airports Council International (ACI), agreed on a series of measures to address environmental issues related to the operation of airports.

Getting aircraft in the air and on the ground

Flights start and end on the ground. A significant volume of noxious emissions may come from systems needed to power aircraft during ground times.

Stationary aircraft require electrical energy (115 volts at 400 Hz) for flight systems and other on-board electrical systems. They may also need preconditioned air (PCA) for heating or cooling of the cabin depending on the ambient conditions.

All jet aircraft have so-called auxiliary power units (APUs) that are small turbines burning aviation fuel to run an electric generator, which provides electric power, air pressure, when the main engines are off, and to start the main engines before departure. APUs can also be used in flight in case of problems with the aircraft's main generators.

Power can be provided to stationary aircraft by ground power units (GPUs) that burn diesel fuel, but emit 20 times less CO₂ than APUs.

Solutions that provide power and PCA from ground installations make it possible to avoid using APUs to power systems, prevent noxious emissions and burn expensive jet fuel. Furthermore, some airports restrict

APU use to, for instance, "to start engine, but no earlier than five minutes before off-block time" (Zürich airport).

Power can be provided by ground energy systems (GES) that include transformers, converters and cables. Cables are usually mounted underneath the passenger loading bridge or on the ground in special ducts.

International Standards for transformers, converters and cables are developed by IEC technical committees (TCs), such as TC 14: Power transformers, TC 22: Power electronic systems and equipment, and TC 20: Electric cables.

Systems that provide pre-conditioned air use chillers and even in some cases produce ice when power is in low demand and cheaper (i.e. at night) to cool PCA during daytime. International Standards for cooling units for household and commercial use are developed by IEC Subcommittee (SC) 59M: Performance of electrical household and similar cooling and freezing appliances.

Once aircraft are about to leave, they have to be pushed back from their gates by low-profile tractors, some using towbars, putting them into a position from which they can taxi using power from their own engines. Until now pushback tractors have been powered predominantly by internal combustion engines; however a new generation of tractors uses hybrid or electric propulsion, a growing trend in the sector.

A recent example of electric-powered tractor is provided by Mototok, a German company which has introduced a series of compact towbarless electric wireless remote-



Duty free area at Dubai international airport

controlled aircraft tugs, the largest of which can manoeuvre aircraft of up to 195 tonnes.

Airports started introducing fleets of electric vehicles, including buses, for various servicing tasks.

International Standards for electric vehicles, secondary [rechargeable] batteries and for plugs, socket-outlets and couplers for industrial and similar applications, and for electric vehicles are developed by TC 69, TC 21 and SC 23H, respectively.

Getting aircraft on the ground to their gates and from these in the air safely

requires the right and reliable lighting systems that can operate in different, often adverse conditions such as heavy cloud cover or darkness.

International Standards for electrical installations for lighting and beaconing of aerodromes are developed by TC 97.

Airports are like small towns... just with more systems

The entire infrastructure and operations of airport depend on electrical systems, from the handling of luggage to and from aircraft, the processing of departing and arriving passengers and crews, including security screening and checks.

Handling luggage requires complex and often energy-hungry systems that are hidden from passengers. Many airports have started looking at ways of cutting down on the energy demand of these systems. This includes the introduction of more energy-efficient drives, such as variable speed drives. International Standards for these are developed by TC 2: Rotating machinery, which has published Standards related to efficiency classes for variable speed drives.

Airports are like small towns, with shopping and food outlets, and systems to move large numbers people around, like escalators and lifts.

As such, airports rely on the same IEC International Standards needed to ensure the smooth operation of large commercial buildings, shopping centres, etc. These include energy-efficient heating, ventilation and air conditioning (HVAC) systems and lighting, alarm systems, sensors, building management systems, etc. International Standards for all these systems are developed by a multitude of IEC TCs and SCs. The introduction of smart and connected systems is set to make airport installations more energy efficient and will require more International Standards, like those needed in smart homes and smart cities.

One aspect that is important too is the movement of people to and from airports and between terminals. In a growing number of airports this movement depends to a significant extent on automated or "self-driving" electric-powered personal transport systems, such as driverless shuttles or innovative pod-type vehicles.

Thirty years of ICT standardization

IoT subcommittee is the new kid on the block

By Antoinette Price

The world has never been more connected and surrounded by ICT. Whether we realize it or not, many aspects of ISO/IEC JTC 1 work affect daily life. From a smart toothbrush, animal tracking collar and household appliances, to health monitoring wearables and smart systems in buildings and transport, the list is endless.

Millions of connected objects

Millions of devices and objects connected with the internet of things (IoT) have built-in sensors, which allow them to gather and share information with relevant systems, often in real time, and to store huge amounts of data in the cloud.

As well as ensuring the quality and interoperability of this technology, the personal data gathered must remain private and secure. This is where standardization comes in, particularly the work of ISO/IEC JTC 1, the Joint Technical Committee of the IEC and the International Organization for Standardization (ISO), and its subcommittees.



RFID labels give food retailers accurate information at fast read rates on short life foods
(Photo:www.healthtard.com)

The ubiquitous internet of things

Given the growing importance of IoT, which is used in many industries and businesses, in November 2016, ISO/IEC JTC 1 decided to establish a new subcommittee ISO/IEC JTC 1/SC 41, focusing on standardization activities for IoT and related technologies. Its first meeting was held in May 2017.

IEC is providing administrative support for the subcommittee, which covers a broad set of IoT-related technologies, such as sensor networking, edge computing and wearables. It will also offer guidance on the development of IoT-related applications to ISO/IEC JTC 1, IEC, ISO and other entities working in this domain.

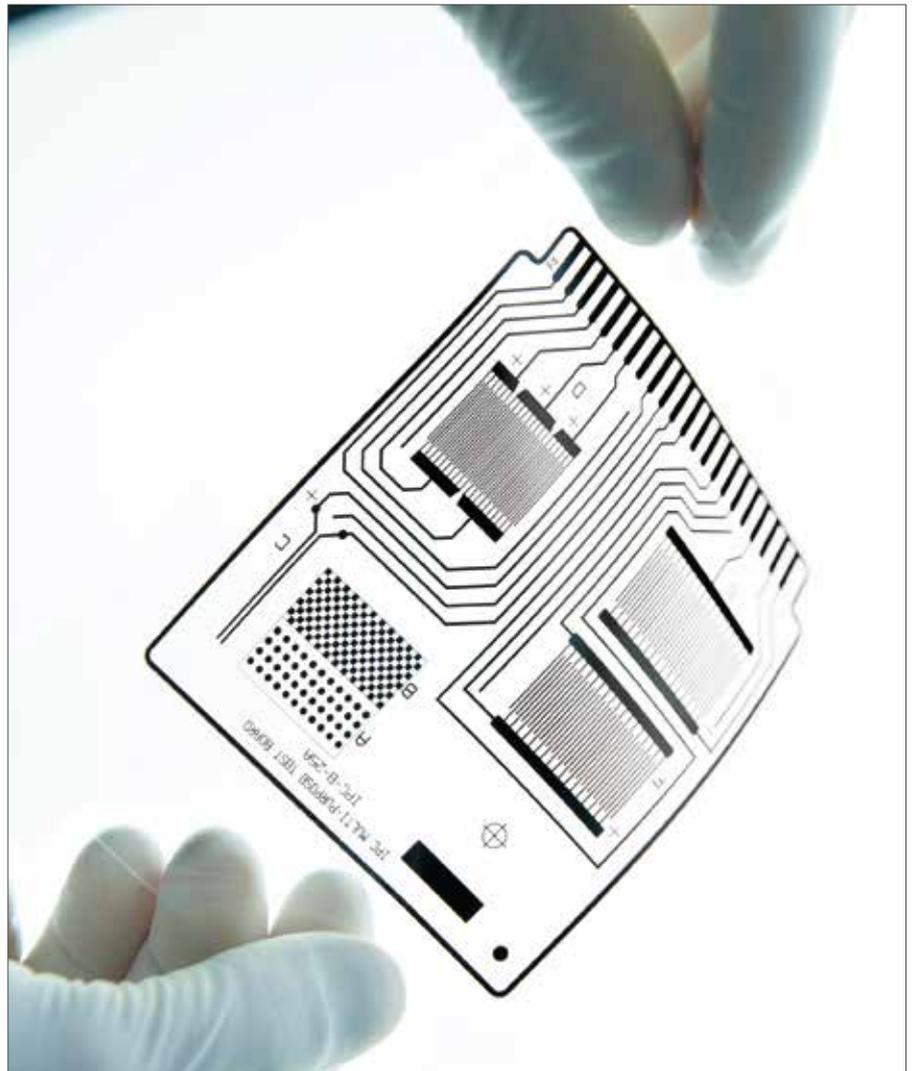
In order to achieve its goals, it liaises with 13 other ISO/IEC JTC 1 subcommittees, which cover among other things, biometrics, cloud computing, data management and interchange and IT security techniques. It also works with a number of IEC technical committees, such as IEC TC 65: Industrial-process measurement, control and automation, IEC TC 124: Wearable electronic devices and technologies, and the Standardization Evaluation Group for smart manufacturing (SEG 7). Additionally, it collaborates with other organizations, for example, the Industrial Internet Consortium (IIC) and the Open Geospatial Consortium (OGC).

From first responder VR training to smart farming

Over the past year, IEC e-tech magazine has reported on a variety of technologies, which come within the scope of ISO/IEC JTC 1 standardization activities.

Seeing through a headset

Virtual reality (VR) is being used in diverse industries, including advertising, construction, military and



Nano silver conductive inks allow direct printing electrical traces on any surface
(Photo: www.clariant.com)

mining, for practising complex surgery, or enhancing classroom learning, but the list continues to grow. For instance, VR applications are helping first responders train for natural and man-made disasters, and are being used for driverless vehicle simulations in intelligent urban infrastructures. These types of simulations help develop both vehicle and infrastructure technology, as the world prepares for a driverless vehicle future.

ISO/IEC JTC 1/SC 24 works on interfaces for information technology-based applications relating to computer graphics and virtual reality, image processing, environmental data representation, support for mixed and

augmented reality, and interaction with, and visual presentation of information.

Tags for tracking items

When products are ordered, they may be made in one place, transit through another and be stored somewhere else before reaching their final destination. Manufacturing plants and giant warehouses are examples of places where numerous components and/or finished products need to be tracked. Barcode labels on supermarket items greatly facilitate the shopping experience, while hospitals use such labels to track medical equipment availability.

Radio frequency identification (RFID) is used widely to automatically identify and track tags attached to objects, as well as store basic information about them.

ISO/IEC JTC 1/SC 31 covers automatic identification and data capture (AIDC) techniques, and publishes International Standards for barcode symbologies and RFID.

Engine parts, human organs and toys – the diversity of 3D printing

3D printers come in all shapes and sizes and use simple plastics, metals, biomaterials, concrete or a mix of materials, to produce a broad variety of objects.

This technology will profoundly affect business models, value chains and global manufacturing. It will allow individual objects to be made in new business environments. It will also enable the cost-effective production of devices and components that cannot be manufactured efficiently using traditional techniques.

However, it raises significant challenges, such as how to handle intellectual property and copyright if anyone can access 3D printing capacities with object models circulating freely on the internet.

International standards play an important role in developing the additive manufacturing market. The data that drive 3D printers must be stored, exchanged, indexed and secured. Protecting data is also critical when manufacturing safety or mission-critical devices or components.

ISO/IEC JTC 1 has created a Study Group on 3D printing and scanning (ISO/IEC JTC 1/SG 3). The group is investigating which IT-related Standards will be required

to support the development of 3D printing and 3D scanning. It will present a comprehensive report, which examines current technology and market trends and offers recommendations for next steps, at the ISO/IEC JTC 1 October 2017 plenary.

Smart everything

Many industries have become smart. In the case of lighting, smart connected lampposts offer more than just light as part of smart city infrastructure. They can guide cars to empty parking spaces, provide drivers with local event and weather information, and if equipped with a screen, create advertising revenues.

An array of smart farming applications, systems and machinery improve farming efficiency and save costs. Animal wearables track herds, while fields send alerts to farmers telling them how much water they need. Agribots can weed between crop rows, and smart milking systems monitor the quality of every drop of milk and the cow's health.

The IoT makes everything that is smart possible, because it integrates virtual complex information technologies, such as communication, networking, identification and security, with the

billions of connected devices and systems.

Several ISO/IEC JTC 1 subcommittees produce International Standards which contribute to the smooth functioning of the IoT (ISO/IEC JTC 1/SC 41), ensuring that the data gathered remains private and secure (ISO/IEC JTC 1/SC 27) and cloud computing for data storage (ISO/IEC JTC 1/SC 38).

Your DNA is the key

Who needs a key when a fingerprint can start the car? You can also forget the complicated code when voice command can activate the home alarm! The use of biometrics is increasing in consumer markets. For example, some car manufacturers are developing user profiles which will authenticate drivers using facial recognition and operate car entertainment systems with hand gestures.

International Standards for biometrics help ensure data security, reliability, quality and interoperability. ISO/IEC JTC 1/SC 37: Biometrics, covers specifications for the security, testing and reporting of different aspects such as data interchange formats, face image data, facial recognition, iris image data and voice command speech recognition.



Smart sensors guide the robot vacuum cleaner around the home (www.irobot.com)

The importance of testing against International Standards

Everyone benefits from using efficient, safe products and services

By Antoinette Price

Today, many devices and services found in homes, hospitals, the workplace and industry run off electricity. Such machines and equipment can be dangerous if they malfunction, causing explosions, fires or electrocuting users or anyone who comes into contact with them, in addition to damaging property.

IECEE, the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and

Components, tests and certifies electrical and electronic equipment. Its Certification Body (CB) Scheme provides the assurance that tested and certified electrical equipment – and its components – meets the strictest levels of safety and performance in compliance with the relevant IEC International Standards.

IECEE CB test certificates issued is expected to exceed 100 000 in 2017, with a total of 96 954 in 2016. The System currently has 53 participating

countries, 78 national certification bodies, 504 testing laboratories and over 2 200 client testing facilities.

Harmonizing collaboration between IEC and ITU

IEC and the International Telecommunication Union (ITU) are working together to provide solutions related to conformity assessment for testing laboratories associated with ITU recommendations.

To achieve this, the IECEE Certification Management Committee (CMC) established a joint IEC/ITU Task Force, mandated to see which IECEE operational and other documents and rules will need to be modified, and to determine the required qualifications in laboratories and staff, in order to incorporate the ITU Recommendations within the scope of IECEE.

Listening to industry

Industry has expressed a need to define market relevant solutions and services related to functional safety in the IECEE CB Scheme. In response, IECEE has set up a task force to identify suitable product groups to start such services. This includes determining the necessary qualification for personnel



Smart manufacturing uses cloud technology to store unlimited amounts of data (Photo: www.cmtc.com)



Smart controllers operate connected kitchen appliances (Photo: www.nordicsemi.com)

performing such services, in terms of educational background, training and experience, defining meaningful working procedures for conformity assessment, and applying a system approach.

Stepping up cyber security

Cyber security is an important element of IECEE work. Many devices, machines and systems are connected and thus part of the internet of things (IoT). They gather, store and exchange confidential information and must do so securely.

Addressing a growing industry need, IECEE Industrial Cyber Security Programme was created to test and certify cyber security in the industrial automation sector. The service provides a framework for assessments in accordance with the IEC 62443 series of International Standards on security for industrial automation and control systems, to result in an IECEE Certificate of Conformity - Industrial Cyber Security Capability.

As manufacturing becomes increasingly smart, more human-machine interfaces are used and artificial intelligence expands along with the use of robotics. Greater risk mitigation is needed in the

development, testing, and certification of these types of equipment or equipment/products/systems using such technologies. Equally, there is the need for competent personnel to conduct the evaluations of the functional safety of industrial installations and equipment.

The IECEE Task Force for the Certification of Personal Competency (CoPC) has been established to include the areas of cyber security and functional safety, among others. It will be based on the successful IECEx CoPC.

From medical wearables to dishwashers

Over the past year, *e-tech* has reported on various industries which use IECEE testing and certification for their products and systems.

The wireless technology revolutionizing healthcare

The medical wearable and medical devices industries are booming. This is largely due to increased awareness of personal fitness and self-monitoring, and to an aging population with greater healthcare and home help needs. According to technology research company ReportLinker,

global connected medical device technologies will reach USD 8,3 billion by 2021, with a compound annual growth rate (CAGR) of 10,8% from 2016 through 2021.

IECEE makes sure that electrical and electronic devices and equipment are reliable and meet expectations of performance, safety and other criteria. The CB Scheme applies to the medical electrical equipment and also covers risks to patients, equipment operators and maintenance personnel. Its tests follow many IEC International Standards, including the IEC 60601 series of Standards on the safety and performance of medical electrical equipment.

Smart homes full of gadgets

Our homes are full of electrical appliances and systems, which help us clean, cook, provide heating, cooling, lighting and entertainment, maintain the garden, do our hobbies and stay secure. As homes get smarter, a growing number of electronic controls operate these items.

We need more energy to run our homes and recharge portable devices, such as tablets and smartphones, even though their energy efficiency is always improving.

In addition to testing and certifying all these appliances and their controls for reliability and safety, IECEE operates the Electrical Energy Efficiency (E3) programme, which supports industry efforts to develop energy-efficient products.

Energy efficiency, meaning the energy performance, consumption and level of noise emission of electrical equipment, is tested in compliance with IEC International Standards, for example, IEC 62301 for measuring standby power of household appliances, including computers and washing machines.

Number one in its field

IECEX leads the way in Ex compliance

By Claire Marchand

Year in, year out, the list of incidents happening in hazardous areas doesn't seem to be diminishing. The oil and gas sector has had its share of fires and explosions, obviously, that have been widely reported both in the general media and in specialized trade publications. But it's not alone. Mining is another sector where risks are high for a number of reasons, including leaks of poisonous gases, dust explosions, collapsing of mine stopes, flooding, or improper use/malfunction of mining equipment, e.g. safety lamps or electrical equipment. Not to mention sugar refineries and food processing plants, and any industry that operates, even partially, in potentially explosive atmospheres.

Mitigating risks

Zero risk may not be conceivable but there are measures that can be taken to mitigate risks and make sure that the equipment used is explosion-proof, that those working in Ex environments do so in the safest possible way. Reducing risks is also important for those living in the vicinity of Ex operations.

The measures that need to be taken include installing and operating equipment that incorporates an



The Deepwater Horizon oil spill, in the Gulf of Mexico, is considered the largest accidental marine oil spill in the history of the petroleum industry

explosion-protection technique as part of its design and manufacturing. It is also necessary to hire staff that has the necessary training, skills and competences to work in hazardous areas.

The IEC, through IECEX, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, has the mechanisms in place to help industry, authorities and regulators ensure that equipment (electrical and non-electrical) as well as the people working in Ex locations benefit from the highest level of safety.

Going strong

Last year, IECEX celebrated the 20-year anniversary of its very first meeting in London (July 1996), which marked a milestone for IEC conformity assessment (CA) as the first CA System to be solely dedicated to a specific industry and technology sector. In 2017, IECEX continues to grow steadily.

IECEX covers equipment for use in areas where flammable and combustible materials are used, handled, stored or transported and which are referred to as Ex areas.

While the IECEx initial service offering was based on the highly successful IECEx CB Scheme, providing for the mutual recognition of test and assessment reports, IECEx went on to develop the IECEx Certification Scheme for Equipment and introduced the IECEx On-line Certificate System where each and every certificate issued by each IECEx approved certification body is fully visible to the public.

Following its initial success, IECEx went on to develop the IECEx Certified Service Facilities Scheme and then the IECEx Certified Persons Scheme both

using the hugely popular IECEx On-line Certificate System.

United Nations endorsement through UNECE

With its three Schemes, IECEx covers all aspects of conformity assessment in the Ex field. In addition to equipment and personnel, the System also provides testing and certification for service facilities that repair and overhaul Ex equipment.

Its global scope has been reinforced by the endorsement it received from

the United Nations through the UN Economic Commission for Europe (UNECE) as the internationally-recognized certification system for promoting the safety of equipment, services and personnel associated with devices, systems and installations used in explosive areas.

Focus on China

The 2017 International IECEx Conference took place in Shanghai, China on 11-12 April. Organized by the IEC and IECEx, together with the Certification and Accreditation Administration of the People's Republic of China (CNCA), in conjunction with the United Nations Economic Commission for Europe (UNECE), the two-day event was a unique opportunity not only to learn more about IECEx, but also to get involved and network with the Ex community.

This year again, the speakers' list included leading experts involved in standardization, equipment manufacturing, inspection, repair and overhaul of Ex equipment and systems, as well as in the assessment and certification of personnel competence. Through their presentations and contacts with participants, they were able to share their experience and knowledge on all matters pertaining to the Ex field with around 400 participants.

Information on the 2017 IECEx International Conference, along with copies of the presentations, is on the IECEx website

Standards for Ex equipment

IEC TC 31 has a complete series of International Standards, IEC 60079, that cover all specific requirements for electrical Ex equipment and systems, from general requirements to protection levels for apparatus used by all sectors that operate in hazardous environments. IEC SC 31M, a subcommittee of IEC TC 31, has developed the ISO/IEC 80079 series



The 2017 IECEx International Conference took place in Shanghai, China, on 11-12 April



Dust explosions are a frequent occurrence in underground coal mines

of Standards, of which two are of particular importance to IECEx:

ISO 80079-36:2016, *Explosive atmospheres - Part 36: Non-electrical equipment for explosive atmospheres - Basic method and requirements*, and ISO 80079-37:2016, *Explosive atmospheres - Part 37: Non-electrical equipment for explosive atmospheres - Non electrical type of protection constructional safety "c", control of ignition source "b", liquid immersion "k"*, dealing with non-electrical equipment and protective systems for explosive atmospheres.

Testing and certifying non-electrical (mechanical) equipment

In 2016, in response to new requests of the Ex industry, IECEx integrated into its operation ISO 80079-36 and ISO 80079-37 into its portfolio. To prevent explosions, both electrical and non-electrical equipment needs to be taken into consideration in a systems approach. IEC and ISO worked closely to prepare these Standards on non-electrical equipment for explosive atmospheres. They provide methods and requirements for the design, construction, testing and marking of non-electrical Ex equipment, Ex components, protective systems, devices and assemblies that are used in explosive atmospheres.

In 2016 also, IECEx commenced issuing certificates according to the ISO 80079-36 and ISO 80079-37 Standards.

Stakeholders

Representatives from industry and regulators form the majority of the IECEx Management Committee (MC), the body charged with overall management of the IECEx System. Stakeholder groups represented on the MC include equipment manufacturers, end users, regulators, testing and certification bodies, Ex

repairers, installers and Ex training organizations and educators.

Recognized Training Providers

In support of the IECEx Certified Persons Scheme and at the request of industry, IECEx developed the IECEx Recognized Training Provider (RTP) programme as a means of recognizing those training organizations that developed their training programmes in support of the IEC Standards and IECEx Certifications Schemes, thereby assisting candidates to be better prepared for undertaking the IECEx Personal Certification Scheme assessment process. The Scheme was launched in May 2015 and there are currently 16 IECEx RTPs listed on the IECEx website with others in the application stage. One of the oil majors, PETRONAS has successfully achieved IECEx RTP status for their own internal training facility.

IECEx Certificates

IECEx operates the only global online certificate system dedicated to the Ex field. Given that most consumers of Ex products are educated consumers, the IECEx online system provides instant verification of claims of compliance, providing the one single

location where certificates issued by more than 90 IECEx certification bodies (ExCBs) can be found with full public access. In addition to the IECEx website, the three IECEx applications, for iOS and Android smartphones and tablets, allow for instant verification of certificates for Ex equipment, Ex service facilities and Ex personnel, both online and offline.

One key aspect of IECEx is that the IECEx Certificate reference number must be included on product labels for clear traceability purposes.

IECEx in a nutshell

IECEx operates industry-specific Schemes and Programmes:

- IECEx Certified Equipment Scheme
- IECEx Certified Service Facilities Scheme
- IECEx Scheme for Certification of Personnel Competence
- IECEx Recognized Training Provider (RTP) Programme

The IECEx Conformity Mark Licensing operates in association with the IECEx Certified Equipment Scheme.

More information on www.iecex.com



Non-electrical equipment used in Ex areas includes among others pneumatic motors (Photo: Globe Airmotors BV)

Smart, safe and reliable

Electronic components of the highest quality through IECQ testing and certification

By Claire Marchand

Inventions of past centuries have paved the way for today's technological innovations. This is the case for many of the electronic components that we use so liberally today. The Leyden Jar, for instance, is the ancestor of the capacitor. Just look at any technology timeline and you'll have the complete sequence of events that leads to the tiniest components and ever smarter devices that connect everyone and everything.

One type of electronic components in particular plays a major role in this world of connectivity and smartness: sensors. Again, sensors find their origin in an invention of the 19th century. According to a website dedicated to explaining sensors in layman's terms, "the first thermostat came to market in 1883, and many consider this the first modern, manmade sensor. Infrared sensors have been around since the late 1940s, even though they've really only entered the popular nomenclature over the past few years."

Sensors, a key technology

Sensors come in many shapes and forms: vision, flow, fibre optic, gas,



Motion sensor (Photo: Wikimedia Commons/Versatile Techno)

motion, image, colour, light, pressure, infrared, photoelectric and so on.

Sensors and sensor systems are a key underpinning technology for a wide range of applications. They can be used to improve quality control and productivity in manufacturing processes by monitoring variables such as temperature, pressure, flow and composition. They help ensure the environment is clean and

healthy by monitoring the levels of toxic chemicals and gases emitted in the air, both locally and – via satellites – globally. They monitor area and regional compliance with environmental standards. They enhance health, safety and security in the home and workplace through their use in air-conditioning systems, fire and smoke detection and surveillance equipment. They play a major role in medical devices, transportation,

entertainment equipment and everyday consumer products.

Technological innovations have brought a new generation of tiny sensors, such as microelectromechanical systems (MEMS) and nanoelectromechanical systems (NEMS). These are smaller, smarter and can be integrated into fixed and portable devices.

But whatever the size of the sensor, the device has to be accurate and reliable. Whatever it measures, the measurement has to be extremely precise. A defective sensor can have serious consequences, even putting human lives in jeopardy.

Safety, reliability and cost-effectiveness

Sensor manufacturers and suppliers all over the world have a powerful tool at their disposal, enabling their products to meet the strictest requirements: IECQ testing and certification. IECQ is the IEC Quality Assessment System for Electronic Components. Established in the early 1970s, the System grew with, and adapted to the technological developments in the electronics industry. The emergence of smart devices and the internet of things (IoT) in the 21st century was also a good time for the System to reorganize: rationalization of the Schemes, review of the documentation, alignment of the Basic Rules with those of the other CA Systems, and a new website with the Online Certificate System.

IECQ Schemes

As the worldwide approval and certification system covering the supply of electronic components, assemblies and associated materials and processes, IECQ tests and certifies components using quality assessment specifications based on

IEC International Standards. In addition, there is a multitude of related materials and processes that are covered by the IECQ Schemes. IECQ certificates are used worldwide as a tool to monitor and control the manufacturing supply chain, thus helping to reduce costs and time to market, and eliminating the need for multiple re-assessments of suppliers.

IECQ operates industry specific Certification Schemes:

- IECQ AP (Approved Process)
 - IECQ AP-CAP (Counterfeit Avoidance Programme)
- IECQ AC (Approved Component)
 - IECQ AC-TC (Technology Certification)
 - IECQ AC-AQP (Automotive Qualification Programme)
 - IECQ Scheme for LED Lighting (LED components, assemblies and systems)
- IECQ Avionics
- IECQ HSPM (Hazardous Substances Process Management)
- IECQ ITL (Independent Testing Laboratory)

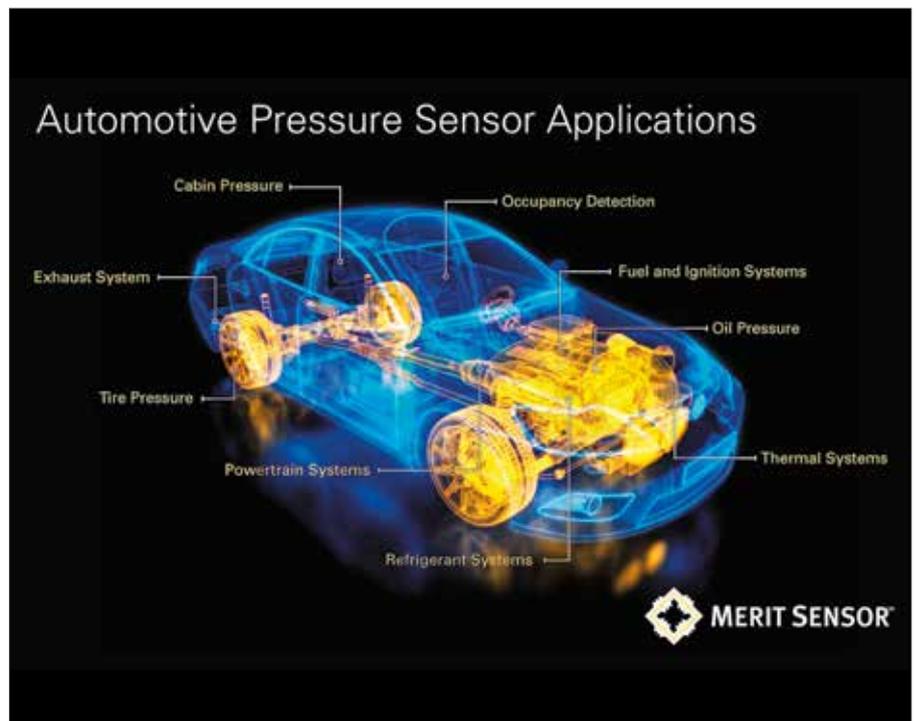
A Scheme for the automotive sector

The IECQ AQP provides the automotive industry with a standardized and cost effective way to ensure that the components they are buying meet expected quality, safety and reliability requirements. This way, automotive manufacturers know how the performances of components compare. IECQ AQP helps automotive manufacturers avoid multiple second-party assessments, tests and related costs.

Shedding light on LEDs

The new IECQ Scheme for LED Lighting, established under the umbrella of the generic IECQ AC Scheme and operational since 2015, issued its first certificate in September 2016 to a Chinese company.

The Scheme can be applied to certify manufacturers and suppliers of electronic components, modules and assemblies used in the production of LED packages, engines, lamps, luminaires and associated LED



Automotive pressure sensor applications (Photo: Merit Sensor)

ballasts/drivers. It provides a standardized approach for evaluating suppliers and is used as a powerful supply-chain management tool when assessing and monitoring the various tier-level providers.

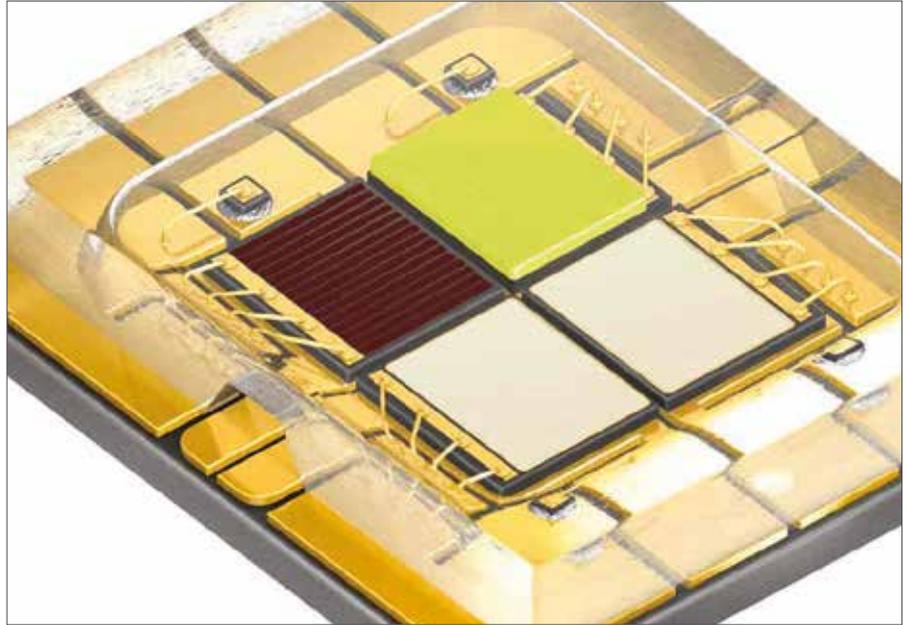
This removes the cost burden of monitoring and controlling the supply chain by reducing the number of second-party assessments and audits, from the original equipment manufacturers (OEMs) to their suppliers, while also protecting the OEM brand name in the market. This also helps prevent poor quality LED systems from entering the market.

During its April 2016 meeting, the IECQ Management Committee finalized and approved for publication the new Rules of Procedures and Operational Documents addressing the certification of manufacturers and suppliers of components used in LED lighting systems.

Targeting hazardous substances

In May 2017, IECQ issued a new edition of its publication IECQ QC 080000, *Hazardous Substance Process Management (HSPM) System Requirements*. The specification and its requirements are based on the strong belief that the provision of hazardous substance-free products and production processes can only be achieved by integrating management disciplines fully. It specifies how organizations establish and implement key processes to manage their hazardous substances other than focusing on the removal and avoiding restricted substances in products.

The new edition of IECQ QC 080000:2017 is available in English, French, Korean, simplified and traditional Chinese and Russian.



High-power LED chip (Photo: OSRAM)

Passing of an icon

Unfortunately 2017 also bore sad news for the IECQ community, with the passing of David W. Smith, the former chair of IECQ and architect of the re-invention and re-engineering of IECQ.

With a career spanning more than 40 years in the electronic component sector, Smith had acquired an invaluable experience. Since the 1970s, Smith had also been involved

in standardization and certification activities, first in the UK, then at the European and international level. At the helm of IECQ since 2003, Smith ended his 10 years (three three-year terms + one extra year) as Chair of the IECQ Management Committee on 31 December 2013.

In 2012, Smith was one of the laureates of the IEC Thomas A. Edison Award.

More information on www.iecq.org



Lead-free smart hub (Photo: Telegea)

Instilling confidence in a whole industry

IECRE System offers a common language for a highly technical product

By Antoinette Price

Established in 2014, IECRE, the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications, is the newest of the IEC Conformity Assessment (CA) Systems.

Comprising three renewable energy sectors, wind, solar photovoltaic (PV) and marine, the System harmonizes the certification process with the result that one certificate is valid for multiple markets.

IECRE issues first certificate

Over the past year, IECRE has issued its first and four subsequent wind turbine certificates to companies in China and Denmark.

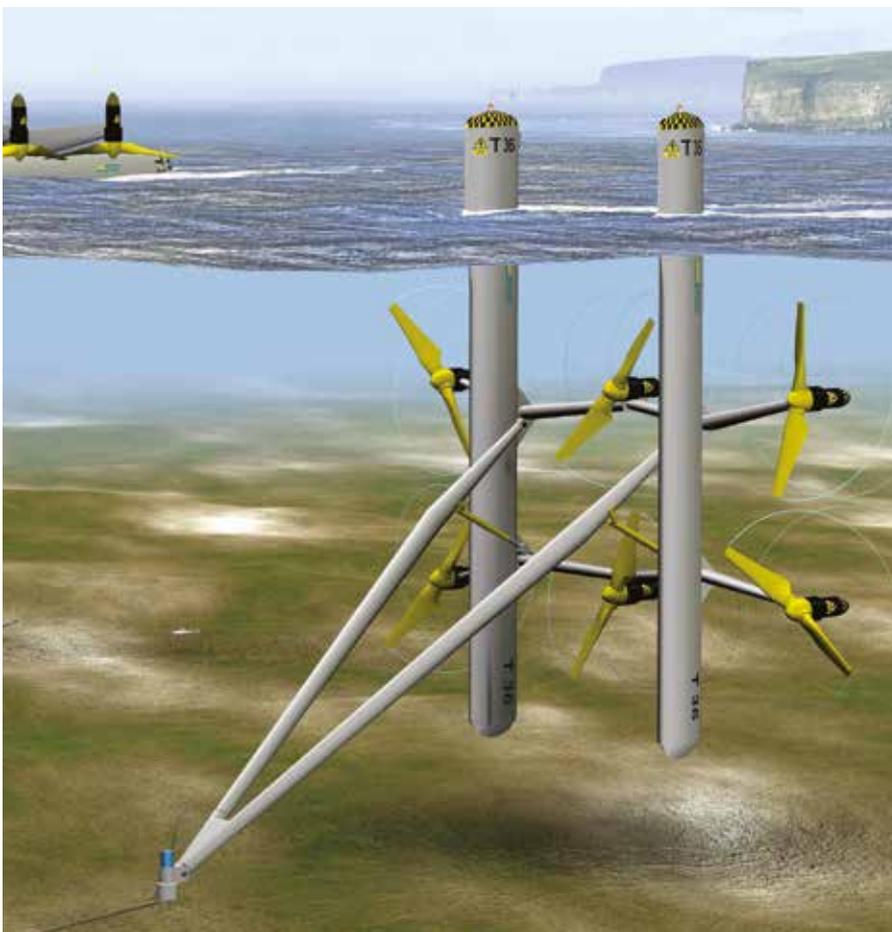
Currently, there are 16 participating countries, eight certification bodies (RECBs), 164 testing laboratories (RETLs) and one inspection body (REIB), with the authority to carry out testing and certification of wind turbines and/or solar PV power facilities.

The solar PV sector expects to issue its first certificate before the end of 2017, while the marine sector has created the required documentation to operate a CA System once the International Standards have been completed and published.

Spreading the word worldwide

As the work evolves, IECRE is being promoted at events and trainings in different countries.

For example, the Chair of IECRE, Sandy Butterfield, presented the marine energy sector at Hydrovision



Triton platform tidal energy device (Photo: TidalStream)



World's longest wind turbine rotor blade (154 m) transported through Denmark (Photo: Siemens)

International, the largest gathering of hydro professionals worldwide, held in Colorado, US, in June.

The System is also being promoted by the MET-CERTIFIED project, managed by the Dutch Marine Energy Centre, which has organized a series of workshops in Belgium, France and the UK, to highlight international certification of marine energy technologies under development by IECRE. The events attract financiers,

insurers, consenting authorities, technology developers, test facilities and certification bodies from the industry.

IEC Vice President and Chair of the Conformity Assessment Board (CAB), Dr Ulrich Spindler, gave a comprehensive presentation of IECRE and its three sectors at the International conference on renewable energy development and technology, in Frankfurt, Germany, in June. The

event was hosted by IEC and the State Grid Corporation of China (SGCC).

George Kelly, member of the RE Management Committee (REMC), presented the solar PV sector of the System at the Sayuri-PV workshop in Tsukuba, Japan, in October 2016, at a PV module reliability workshop in Colorado, US, in March this year, and at the 44th IEEE PV Specialists Conference in Washington held in June.

A global approach

Strong IEC presence on five continents through its regional offices

By Claire Marchand

All IEC regional centres are focal points for IEC standardization activities in their respective part of the world. They have greatly contributed to raising awareness on and promoting the Commission through country visits, participation in international, regional and national events, networking and establishing an ever growing number of invaluable contacts.

East, west, north and south

Since 2001, when the IEC Regional Centre for North America (IEC-ReCNA) opened in Worcester, Massachusetts, the IEC has gradually established regional offices in different parts of the world. The Asia-Pacific Regional Centre (IEC-APRC) was launched in Singapore in 2002, followed by the Latin America Regional Centre (IEC-LARC) in São Paulo, Brazil, in 2007 and the Africa Regional Centre (IEC-AFRC) in Nairobi, Kenya, in 2015.

The IEC has also been present in Australia for more than 20 years through the Secretariats of two IEC Conformity Assessment (CA) Systems – IECEX, the IEC System for Certification for Standards Relating

to Equipment for Use in Explosive Atmospheres, and IECQ, the IEC Quality Assessment System for Electronic Components – whose secretariats are located in Sydney.

IEC-AFRC

Since its official opening in November 2015, the IEC-AFRC has covered a lot of ground, both literally and figuratively.

The Centre is run under the joint-leadership of Evah Oduor and François Yapo Ahoti. Oduor, from

Kenya, has extensive know-how and expertise in standardization work – she was IEC Coordinator for Africa – and conformity assessment – she is a Vice-President of the African Electrotechnical Standardization Organization (AFSEC) responsible for CA activities. Ahoti, from Côte d'Ivoire, joined the IEC from the United Nations Industrial Development Organization (UNIDO) where he worked as a Chief Technical Adviser in Standardization and Quality.

In less than two years, both have crisscrossed the African continent to



IEC-AFRC Directors François Ahoti (left) and Evah Oduor

meet with national committees (NCs) in IEC member countries, with national electrotechnical committees (NECs) in affiliate countries and with key stakeholders everywhere, including regulators, governmental agencies and organizations, utilities, academia and consumers. The objective has been – and continues to be – to make valuable contacts and to evaluate the needs for assistance to enhance participation in IEC work.

IEC-AFRC works closely with AFSEC and has also established relationships with a number of regional organizations such as the African Energy Commission (AFREC), the African Organization for Standardization (ARSO), the East African Community (EAC) the Economic Community of West African States (ECOWAS) and its Centre for Renewable Energy and Energy Efficiency (ECREEE), the Southern African Development Community (SADC), the West African Economic and Monetary Union (UEMOA).

IEC-APRC

IEC-APRC is celebrating its 15th anniversary this year.

Since 2002, the Centre has played a major role in raising awareness of the IEC, increasing the use of International Standards and CA Systems and maximizing participation of all countries in the region in the Commission's work. It has established communication and networks with key players from industry, businesses and governments.

IEC-APRC Regional Director Dennis Chew and his colleagues regularly participate in conferences, workshops, forums and meetings, many of those organized by regional standards and regulatory bodies such as the Pacific Area Standards Congress (PASC), the Association of Southeast Asian Nations (ASEAN) and the Asia-Pacific Economic Cooperation (APEC). It is worth noting that in 2015, the 21-member APEC economies were home to around 2.8 billion people and represented approximately 59% of world gross domestic product (GDP) and 49% of world trade.

Cooperation with regional fora has been strengthened with the signing of the co-operation agreement between IEC and the South Asian Regional Standards Organization (SARSO) in

October 2016 in Frankfurt, Germany. Amongst others, the agreement will encourage the use and adoption of IEC International Standards as well as the use of IEC Conformity Assessment Systems in the region.

On the technical side, IEC-APRC provides support for 54 IEC technical committees and subcommittees (TC/SCs) and holds the secretariat of the Advisory Committee on electricity transmission and distribution (ACTAD) and the Advisory Committee on energy efficiency (ACEE).

Located in a research and development hub in Singapore, IEC-APRC offers meeting facilities for IEC activities. In 2016, the APRC hosted 21 meetings.

The IEC-APRC team: Dennis Chew (Regional Director), Suzanne Yap and Damien Lee (Technical Officers), Teo Poh Luan, Amelyn Ching and Pang Chia Li (Assistants).

IEC-LARC

Established in 2007 in São Paulo to develop promotional activities in the Latin America and Caribbean Region, IEC-LARC is celebrating its 10th anniversary this year. Its Regional Director is Amaury Santos.

IEC-LARC was set up to actively encourage the use of IEC International Standards and CA Systems and to enhance participation of countries in the Latin America region. Since its inception, the centre has seen new countries join the list of IEC members. IEC-LARC also works closely with the Latin American countries that participate in the IEC Affiliate Country Programme, notably countries of the Andean Community and Central America.

IEC-LARC provides support to the Forum of IEC National Committees of the Americas (FINCA) and works



The IEC-APRC team: From left (front): Damien Lee, Dennis Chew and Suzanne Yap; (back) Teo Poh Luan, Amelyn Ching, and Pang Chia Li



The IEC-LARC team: Amaury Santos (left) and Iris Szterenlicht

continuously on strengthening ties with many important standards organizations in the region to encourage their members to participate actively in the IEC. Those

include in particular the Pan-American Standards Commission (COPANT), the Council for Harmonization of Electrotechnical Standards of the Nations in the Americas

(CANENA) and the Caribbean Community (CARICOM) Regional Organization for Standards and Quality (CROSQ)

IEC-LARC attends, coordinates, and organizes events that match the needs of the region. They range from training seminars on the use of IEC IT tools to workshops on specific technical areas.

The IEC-LARC team: Amaury Santos (Regional Director) and Iris Szterenlicht (Assistant)

IEC-ReCNA

The first regional centre established by the IEC, IEC-ReCNA has been operational since 2001. The centre, located in Worcester, Massachusetts, USA and headed by Tim Rotti, provides support for 40 IEC TCs and SCs, particularly those with secretariats located in North America, as well as multiple advisory committees.

It holds the secretariat of the Market Strategy Board (MSB), Systems Committee (SyC) Smart Energy, Standardization Evaluation Group (SEG) 7: Smart manufacturing, and the Advisory Committee on applications of robot technology (ACART).

IEC-ReCNA also offers training sessions on its premises for TC/SC Officers and hosted several important technical meetings.

As Secretary of the MSB, Peter Lanctot coordinates the publication of all IEC White Papers.

The IEC-ReCNA team: Tim Rotti (Regional Director), Peter Lanctot (MSB Secretary), Andrew Redgate (Technical Officer), Marlene Maillet and Holly Ducharme (Assistants).



The IEC-ReCNA team: From left: (front): Marlene Maillet, Peter Lanctot and Holly Ducharme; (back): Tim Rotti and Andrew Redgate

IEC future leaders and experts

IEC Young Professionals workshop, Vladivostok, Russia

By Janice Blondeau

IEC National Committees have selected the IEC 2017 Young Professionals who will represent them at this year's workshop, to be held in Vladivostok, Russia, from 9-11 October 2017, during the IEC 2017 General Meeting.

Go Ahead, Get ahead

The IEC Young Professionals (YP) Programme brings together the world's up-and-coming expert

engineers, technicians and managers, aged in their early 20s to mid-30s.

IEC Young Professionals are selected by their IEC National Committee (NC) to represent their country as future leaders on the IEC global platform. They are also potential ambassadors for National Committees and for the IEC as a whole.

While these young experts and managers already have experience in using or developing Standards, the Programme helps them to

become more involved in IEC related activities.

Growing the next generation

For the 2017 workshop, 37 NCs have registered over 70 participants. For many of those taking part, this workshop will be their first exposure to an IEC General Meeting and to standardization and conformity assessment at such a high level.

The IEC Young Professionals Programme was launched in 2010 to enable millennials to be more involved in IEC activities at the start of their careers.

Vladivostok workshop

A welcome gathering on the first evening gives participants the chance to meet one another and the IEC Officers. The rest of the programme provides both an overview and insights into the workings of the IEC. Day one provides an introduction to how the IEC works and the opportunity to hear from and meet IEC leaders.

Participants will be introduced to the Standardization Management Board (SMB) and the Conformity



The IEC Young Professionals Programme provides the world's upcoming expert engineers, technicians and managers...



...with opportunities to shape the future of international standardization and conformity assessment in electrotechnology

Assessment Board (CAB), and they'll have the opportunity to observe the SMB or CAB meeting.

The 2017 Young Professionals will have the opportunity to work together in breakout groups to answer questions on the digital transformation of IEC work, and its impact on how Standards will be developed and used.

Building close ties

The IEC Young Professionals will attend a breakfast with their NC Officers to reinforce this relationship which plays an important part in getting more involved post-

Vladivostok, one of the key objectives of the YP Programme.

They will also observe a technical meeting of their choice, participate in a technical committee simulation session and present their outcomes from the breakout sessions of the day before to their peers, IEC Officers and Council Board (CB) members.

Expanding the IEC Family

Very positive feedback has been received from YPs who participated in the previous workshops. They have gained a deeper understanding of

standardization, a broadened network and the satisfaction of feeling part of a bigger world in which they have a personal role to play.

In addition, companies have also benefited from the workshop, providing their staff with fast-track access to the world of standardization and boosting their personal motivation.

Let's help the IEC Young Professionals to continue to develop in their IEC work and make them welcome within the IEC family!

Strengthening participation

IEC Affiliate Country Programme committed to provide invaluable support to developing countries

By Claire Marchand

Each year sees an increase not only in the number of countries participating in the IEC Affiliate Country Programme but also in the number of International Standards adopted as national ones, national electrotechnical committees (NECs) established and Affiliate Plus status granted. In the past 12 months, the Affiliate Secretariat has been extremely busy supporting participants in the Programme through workshops, seminars, webinars and training sessions, to name but a few of the support activities organized to raise awareness and know-how in developing countries.

A full agenda

Also growing is the number of events attended by the team of two – Executive Affiliate Secretary Françoise Rauser and Project Coordinator Thomas Robertson – or those representing the Affiliate Country Programme in their respective regions, i.e. the Affiliate Leader, Rosario Uría, and the Regional Directors of the IEC Regional Centres in Africa (IEC-AFRC), Asia-Pacific (IEC-APRC)

and Latin America and the Caribbean (IEC-LARC).

Not forgetting the nitty-gritty of the Programme: supporting, and giving advice to individual Affiliate countries upon request; encouraging more active participation in the

Programme and the adoption of IEC International Standards as national ones; assisting in the establishment of national electrotechnical committees (NECs); liaising with IEC members to set up partnerships for the Affiliate Mentoring Programme; and taking the time to explain what is expected of new countries wishing to join the



Support to affiliate countries comes in many forms, including webinars



The IEC participated in the ARE Forum for energy access investment - featured here is the Sioma solar microgrid project in Zambia (Photo: Empowered By Light)

Programme and what the benefits are, and so forth.

The IEC family is still growing

Since the Frankfurt GM, two countries have joined the Affiliate Country Programme: Liberia in November 2016 and Cabo Verde in January 2017. They bring the total number of countries in the IEC family to 170 – 83 members and 87 affiliates.

In September 2016, after an invitation to participate in the Affiliate Country Programme was extended to Liberian authorities and a follow-up from the IEC Africa Regional Centre (IEC-AFRC), the Ministry of Commerce and Industry expressed its interest in IEC activities. Two months later, Liberia's commitment to the Programme became official.

Following an invitation to join the Programme, IEC-AFRC established

a direct contact with the Instituto de Gestão da Qualidade e da Propriedade Intelectual (IGPI) – the Institute of Quality Management and Intellectual Property – and in January 2017, Cabo Verde became the 87th affiliate country.

It is worth noting that, with Liberia and Cabo Verde in the Affiliate Country Programme, all 15 countries in the Economic Community of West African States (ECOWAS) are now in the IEC family – one associate member (Nigeria) and 14 affiliates (Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Senegal, Sierra Leone and Togo).

National, regional and international events

As in previous years, the Affiliate Secretariat team participated in several events of importance for the

Programme and for the IEC in general. They include:

AIDMO High Consultative Committee on Standardization, Rabat, Morocco

In June 2016, the IEC and the Arab Industrial Development and Mining Organization (AIDMO) signed a collaboration pledge to encourage AIDMO members that are also IEC affiliate countries to participate actively in the IEC Affiliate Country Programme. On 1-2 December, the IEC attended the 47th meeting AIDMO's High Consultative Committee for Standardization in Rabat, Morocco.

AIDMO membership comprises eight countries that are IEC full members, four that are IEC associate members and six that are IEC Affiliates. Three countries are not in the IEC family at this date: Djibouti, Libya and Somalia. It was the occasion for the IEC to present an update on its activities



Amaury Santos and Françoise Rauser participated in a workshop and meetings in Lima, and were invited to speak on national radio and television (Photo: INACAL)

and to meet with representatives from Sudan, Palestine and Lebanon.

ARE Forum, Lisbon, Portugal

IEC participated in the annual Alliance for Rural Electrification (ARE) Forum for energy access investment, which took place in Lisbon, Portugal, on 22-23 March 2017. ARE is an official partner of the IEC Affiliate Country Programme since 2014. Its mission is to bring access to electricity to all by 2030, therefore meeting the United Nations Sustainable Development Goal (SDG) 7: Affordable and clean energy. With a multi-stakeholder approach, ARE is also partner of the UN Sustainable Energy for All (SE4ALL) with a focus on four areas: policy dialogue, private sector, capacity building and finance access. Rauser was invited to share IEC experience in a panel on technical assistance for rural electrification. She emphasized the need for International Standards that are not always taken into account, even though they remain a major

component of any national quality infrastructure. IEC will continue to support the SE4ALL initiative and intensify its collaboration with ARE.

DCMAS Network annual meeting

The IEC, represented by Thomas Robertson, met with its partners of the DCMAS Network in Vienna on 29 June 2017 to exchange experiences and updates on developments and to see what scope there may be for supportive actions. In particular, collaborative action in assisting developing countries to reinforce their national quality infrastructure, including metrology, standardization, conformity assessment (CA) and accreditation aspects. To prepare this meeting, representatives from ISO, the UN Economic Commission for Europe (UNECE), International Trade Centre (ITC) and IEC met at IEC Central Office on 7 June 2017 to agree on a common definition of the notion of quality infrastructure covering the areas of metrology, accreditation, conformity assessment and standardization.

National workshop in Peru

Rauser, together with IEC-LARC Director Amaury Santos, participated in a three-day event in Lima, Peru, on 26-28 June 2017. The objective was to raise awareness among major stakeholders and decision makers to support Peru membership in the IEC.

During a high-level meeting with Instituto de Calidad (INACAL) top management, IEC representatives explained that Peru had reached the limits of the Affiliate Plus status and outlined advantages of joining the IEC.

INACAL and the Peruvian NEC organized a public conference on energy quality and safety, followed by a workshop with NEC stakeholders in view of upgrading their participation in IEC standardization and conformity assessment activities.

In the framework of the World Accreditation Day, the IEC held a workshop on its CA Systems focusing

on dangerous environments, renewable energies, as well as electronic components and electrical equipment. The benefits of the Affiliate Conformity Assessment Status (ACAS), in particular the e-learning modules, were underlined. During the visit the IEC met with representatives of the ministries of energy, industry and communication and was invited to speak on national television and radio.

WTO TBT Committees

The IEC attended the World Trade Organization (WTO) Technical Barriers to Trade (TBT) Committee meetings in November 2016, March and June 2017. The Commission presented its report highlighting activities of the IEC, its members, affiliates and regional centres geared to increasing the participation of developing and industrializing countries in IEC international standardization and conformity assessment activities.



Back to back with its regular meeting, the TBT Committee held thematic sessions on technical assistance (November 2016), conformity assessment procedures and good regulatory practices (March 2017) as well as risk assessment (June 2017). At the thematic session on conformity assessment, the IEC Conformity Assessment Board (CAB) Secretary gave a presentation on the IEC CA Systems. He explained the essential goal of a global CA System in facilitating market access through recognition of conformity assessment results from anywhere in the world within the CA System.

Mentoring

Three new mentoring partnerships, between Gambia and the Netherlands, Namibia and the UK, Senegal and France, were established since the Frankfurt GM. The objective of the two-year partnerships is to reinforce the NEC through a number of activities, including identifying and reaching out to relevant stakeholders, encouraging national adoptions and implementation of IEC International Standards, establishing mirror technical committees and participating in IEC work.

In all, the Programme has set up 14 partnerships between IEC members and affiliates.

Mentoring meetings in Frankfurt...

During the Frankfurt GM, a number of bilateral meetings took place between mentors and mentees: Bhutan and Sweden, Côte d'Ivoire and France, DR Congo and France, Ecuador and Mexico, Mongolia and Germany met face to face and were able to review progress made so far and establish action plans.

...in Paro...

The NEC of Bhutan held a workshop on 27-30 March 2017 in Paro, with

the participation of its mentor, the Secretary of the Swedish National Committee, accompanied by three other Swedish experts. The programme included a discussion with Bhutan Standards Bureau (BSB) on Bhutan wiring code, energy efficiency and hydropower Standards, followed by a workshop on Strategy and prioritization of Standards. The workshop focused amongst other things on the responsibilities, structure and duties of a technical committee as well as the relation between IEC Standards and conformity assessment.

...and in Abidjan

The Affiliate NEC of Côte d'Ivoire held a workshop on 24-26 April 2017 with the participation of its mentor, the Secretary of the French National Committee. IEC-AFRC supported the event. The workshop, which aimed to raise awareness of stakeholders and decision makers with the objective for Côte d'Ivoire to become an IEC associate member in 2017, attracted more than 200 participants representing ministries, regulators, private sector and civil society organizations, academia and laboratories.

ACAS

The Affiliate Conformity Assessment Status (ACAS) was launched in 2013 to raise awareness and provide a better understanding of the specific requirements linked to conformity assessment (CA) activities.

e-learning modules

As part of ACAS, e-learning modules help further affiliates' understanding of and involvement in IEC CA activities. Three ACAS e-learning modules are now available on the IEC website, covering IECEE and the CB Scheme, IECEx and IECRE. The IECQ module is expected to be ready soon and a

The mentoring programme, a two-year partnership between an IEC member and an affiliate country, aims at reinforcing the NEC through a number of activities



The ACAS e-learning courses on the IEC Conformity Assessment Systems are available free of charge on the IEC website

final set of modules on global quality infrastructure is expected to be online in early 2018.

The ACAS e-learning courses on the IEC Conformity Assessment Systems are available free of charge through the following link: www.iec.ch/affiliates/acas/e-learning

ACAS capacity building events

Within the ACAS framework, regional seminars help raise awareness on IEC CA Systems and activities. These gatherings are a great opportunity for experts to reach out to stakeholders in the region, provide an overview of IEC activities and focus on the IEC Systems and the ACAS e-learning courses.

IECEE COPANT ACAS Regional Seminar – San José, Costa Rica

The IEC, in collaboration with the Pan American Standards Commission (COPANT), the German National Metrology Institute (PTB - Physikalisch-Technische Bundesanstalt), the Costa Rican National Standards Institute (INTECO - Instituto de Normas Técnicas de Costa Rica), and the Costa Rica national electrotechnical committee (NEC) held an ACAS regional seminar on 23-25 November 2016 in San José, Costa Rica.

The seminar focused on the topic of IECEE, the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components. It provided a general overview of the IEC and its Conformity Assessment Systems before going into detail on topics such as its CB Scheme and the application of IEC International Standards in a laboratory setting. The seminar also provided capacity building for Affiliate countries to further strengthen their NECs whilst increasing the benefits that can be derived from using IEC International Standards and participating in IEC work.

An international audience composed of regulators and national standards body members attended, including delegates from Barbados, Bolivia, Colombia, Costa Rica, Dominica, Ecuador, Guatemala, Haiti, Honduras, Peru, Saint Lucia, and Trinidad and Tobago.

AFSEC ACAS Regional Seminar – Nairobi, Kenya

On 12 January 2017, the IEC, in collaboration with the African Electrotechnical Standardization Commission (AFSEC), held a regional seminar in Nairobi on the ACAS e-learning modules, back to back with the AFSEC Conformity Assessment

Committee (CAC) meeting held on 13 January. Michel Brénon, an IECEE and IECEx expert who collaborated on the development of the ACAS e-learning course, took participants through a number of modules to give a detailed look at the ACAS e-learning course and information on the IEC CA Systems. An international audience attended with delegations from Côte d'Ivoire, DR Congo, Egypt, Ethiopia, Ghana, Kenya, Namibia, Nigeria, Rwanda, Senegal, South Africa, Sudan, Zambia and Zimbabwe.

Upcoming event in Peru

A two-day event is scheduled for 14-15 November 2017 in Lima, Peru. The IEC, in collaboration with COPANT and PTB, will hold a seminar aimed at the same participants as last year, to build on what was done in Costa Rica to further develop capacity in international standardization and conformity assessment.

Affiliate Plus, adoptions and NECs

Since the Affiliate Country Programme began in 2001, more than 6 200 IEC International Standards have been adopted as national ones in 50 affiliate countries, five of which have become IEC members.

To date, 56 countries have established their NEC with representatives of the public and private sectors, and 30 have become Affiliate Plus.

To qualify and upgrade to Affiliate Plus, countries have to fulfil two criteria:

- Adoption of at least 50 IEC International Standards as national ones or for reference in national regulations
- Establishment of a NEC with representatives from both public and private sectors

More information on the Affiliate Country Programme: www.iec.ch/affiliates/

2017 IEC Awards

Recognizing excellence and commitment to the IEC

By Morand Fachot

Every year the IEC honours the commitment and work of a number of individuals in its community who, through their leadership and technical expertise, have contributed to making products and electrical systems safer, more energy efficient, more reliable and more compatible.

Thomas A. Edison Award

Created in 2010, the IEC Thomas A. Edison Award recognizes exceptional achievements of technical committee/subcommittee (TC/SC) officers and their IEC Conformity Assessment Systems counterparts.

To be nominated, TC and SC officers need to be active in IEC work. They must also have made an outstanding contribution to IEC systems and international standardization work, helping their committees to work more effectively on behalf of key stakeholders. The Award is given to up to nine recipients each year by the Standardization Management Board (SMB) and the Conformity Assessment Board (CAB). Seven of these are reserved for TC/SC officers, and a maximum of two for officers in the CA bodies.

In 2017, the SMB chose five TC/SC Officers:

- Kyung-Tae Kang, Secretary of IEC TC 119: Printed electronics
- Joseph Musso, Secretary of IEC TC 72: Automatic electrical controls
- Fumio Ueno, Chair of IEC TC 105: Fuel cell technologies
- Uberto Vercellotti, Past Chair of IEC TC 89: Fire hazard testing
- Peter Zwanziger, Past Chair of IEC TC 22: Power electronic systems and equipment

Four of the 2017 IEC Thomas A. Edison Award laureates – Kyung-Tae Kang, Joseph Musso, Fumio Ueno and Uberto Vercellotti – will receive their honours from IEC Vice-President and SMB Chairman Ralph Sporer during the SMB session at the 2017 IEC General Meeting (GM) in Vladivostok, Russia. The ceremony for Peter Zwanziger will take place at a later stage.

- Joe Gryn, Chair of IECEE Peer Assessment Committee (PAC)
- Alexander Zalugin, Vice-Chair of IECEX

Dr Zalugin will receive the award from IEC Vice-President and CAB Chairman Ulrich Spindler during the CAB session



IEC Thomas A. Edison Award medal

at the 2017 IEC GM in Vladivostok. Joe Gryn will receive his at a later date.

1906 Award

The IEC 1906 Award was established in commemoration of the Commission's foundation in that year and honours technical experts around the world whose work is fundamental to the IEC. Each year a maximum of five awards may be granted per TC, including its various subcommittees.

A total of 175 experts from 56 TCs (including ISO/IEC JTC 1) and 12 experts from the four CA Systems, representing 25 national committees, were nominated to receive this year's 1906 Award. It recognizes exceptional recent achievements that contribute in a significant way to advancing the work of the Commission.

Share your work

We'd like to hear and read your stories

By Claire Marchand

Take the 170 countries in the IEC family, the 20 000 technical experts who work in standards development, the many certification bodies (CBs) and test laboratories (TLs) in the IEC Conformity Assessment (CA) Systems, and add to the mix the rapid pace at which technologies are evolving today and you have hundreds, if not thousands of stories that can be told within the IEC community.

Reaching a large audience

Each month, *e-tech* covers a topic that is specific to IEC work and describes what technical committees/subcommittees (TC/SCs) and the four CA Systems do in that field. Reports on international and regional conferences, workshops and seminars, organized by the IEC or attended by IEC representatives, are also featured.

On the one hand, as in previous years, the *e-tech* editorial team will be reaching out to you to get your story. On the other, you shouldn't hesitate to contact us – some of you have already done so in the past – if you think you can contribute to a specific issue in one way or another. In 2018, we plan



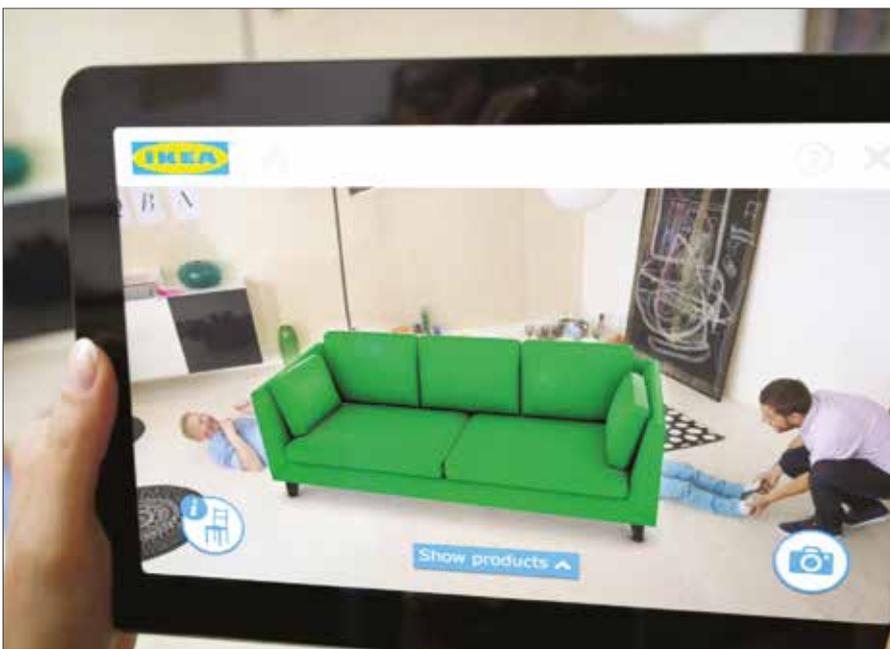
Virtual reality is increasingly used in the medical sector (Photo: medicalfuturist.com)



Railway issues will be featured in issue 03/2018 (Photo: Tomasz Lisiecki)



Renewable energies, including solar thermal energy, have a major role to play in environmental issues



Augmented reality applications display 3D models of various products

to continue and increase the sharing of stories, get your input and include articles that are of direct relevance to your area of expertise.

This is our editorial plan for *e-tech* in 2018. We do look forward to receiving your comments, news and suggestions.

Issue 01/2018

Consumer electronics & multimedia

IBC and CES latest trends / IoT / AR/VR applications (etail, culture, tourism, education, entertainment, training etc.) / wearables / smart appliances / TV and interactive mixed reality (IMR) / IP ratings

Issue 02/2018

Environment

Energy efficiency / refrigerants (Montreal agreement) / natural disaster prevention and mitigation / renewable energies (wind, solar PV, CSP, marine and hydro) / clean transportation means / monitoring of energy usage / waste management / hazardous substances

Issue 03/2018

Transportation

Avionics and aviation / railway / autonomous vehicles (cars and public transport / wireless charging) / sustainability

Issue 04/2018

Review of the year

Issue 05/2018

Medical

Use of AR/VR in the medical sector / wearables / telemedicine / AAL

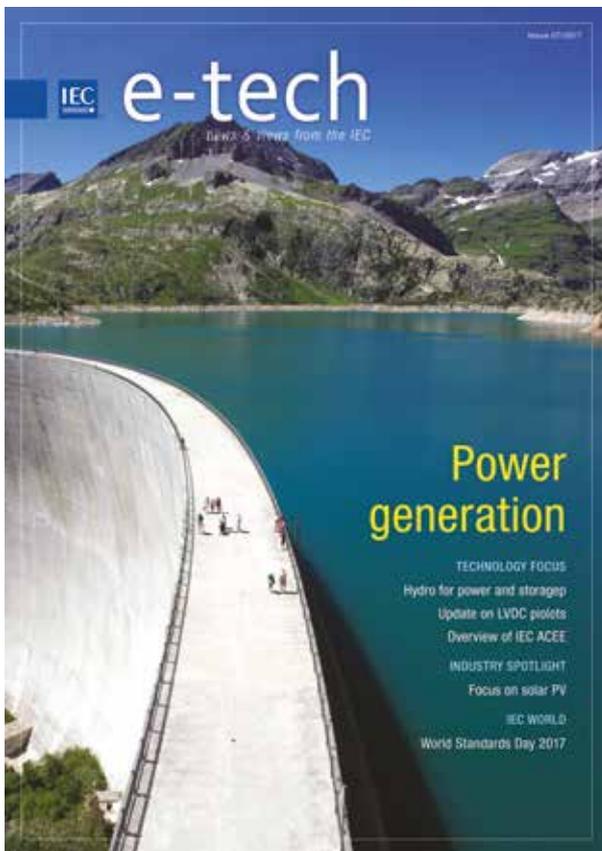
Issue 06/2018

GM special

Overview of IEC technology zones

In the next issue:

Power generation - Issue 07/2017



Issue 07/2017 will focus mainly on hydropower, the oldest and still largest source of renewable energy. It is also the main source of storage needed to balance intermittent power generation from the "new" renewables, like solar and wind.

e-tech will report on a visit to a hydro-based generation/storage installation, the Veytaux pump-storage station near Montreux, Switzerland. Hydropower installations are designed to operate for decades, however maintenance and upgrades are also necessary and require extensive work, as explained by an expert.

e-tech will look at the model testing of hydropower equipment carried out by the Laboratory for Hydraulic Machines (LMH) of the Swiss Federal Institute of Technology in Lausanne (EPFL). The LMH is the world's only independent laboratory for the testing of hydraulic turbines, pumps, pump-turbines, and a range of other equipment used in hydraulic applications.

Low-voltage direct current and solar PV technologies will also feature in issue 07/2017

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e-tech
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