

AEMT Journal

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ASSOCIATION OF ELECTRICAL AND MECHANICAL TRADES



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The future of the service/repair industry

Copper in a Circular Economy

Siemens Digital Twin

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Journal

Front cover photos:

Main Image: Where does the future of the services industry lie?

Top right: The electrically driven Tesla Semi truck.

Bottom right: Siemens Ditigal Twin Concept

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EDITOR'S COMMENT

For the final edition of the 2018 Journal's we've brought you a special edition from the AEMT Conference. Many thanks to our speakers who took the time to summarise the content of their talks for the sake of this publication. Whether you made it to Coventry or not, I hope you find the supporting articles of interest, and that they may stir some interesting debate among colleagues.



We start this edition with some great news about the Ex courses, which are due to be recognised by the IECEx in January 2019 – hopefully by the time you read this article! We have also formed a partnership with the British Gear Association (BGA) to bring a special AEMT Members discount to their training courses, which I hope many members will both appreciate and find to be helpful as part of their continual professional development.

Following up on his talk at the Conference, Dr. Martin Killeen provides an overview of the new repair standard, IEC 60034-23, which the AEMT has chaired the development of. The standard is the first to reference the circular economy, and the article looks at both the reasons for mentioning the concept, as well as the key areas of interest for service centres.

Finalists for the AEMT Project of the Year 2018, Rapid Solutions explores how they won a major submersible pump repair contract by using a new technology to improve their productivity.

Conference speaker, Dr. Paul Dewison, who was commissioned by the International Copper Alliance to examine the use of copper in the coming years, provides us with an overview of how the use of copper will help us to achieve a truly circular economy.

Perhaps the article which will cause most debate is Titos Anastassacos's look at the future of the service and repair industry. His talk at the conference certainly stirred debate! His supporting article looks at history's most pivotal technologies and predicts, by looking at current trends, how the electric motor service and repair market is due for a shakeup.

An informative look at pump efficiencies is provided by Sulzer. By using a proactive maintenance and a durable coating system, cavitation wear on submersible pump impellers can be avoided.

New members to the AEMT, Camis Group give an overview of their expertise in the electric motor market and in bespoke electronics, a couple of remarkable case studies reveal how innovative some of their projects can be.

Dr. Christian Mundo from Siemens spoke to AEMT members about the Digital Twin at the conference, a supporting article examines how a suite of new technologies can be used to take advantage of the massive data now being made available to maintenance teams.

Back in September at the Southern Area Meeting in Chatham, Michael Wooldridge of NTN informed members on what to look out for in knock-off bearings. His supporting article takes a closer look at how counterfeiters are using increasingly clever ways to fool consumers into thinking their product is the real deal.

Finally, we celebrate the first joint AEMT Conference and Awards with a write-up and selection of the day's best pictures, including the winners of this year's award categories. For those interested in seeing the days highlights, we have a very good video published now available to watch on both the conference and awards websites: (www.aemtconference.com and www.aemtawards.com)

Thomas Marks,
Editor.

Take the crisis out of an

Emergency



AEMT members are highly skilled Electrical and Mechanical engineers often prepared to work round the clock to collect, repair and return faulty equipment, and keep downtime to a minimum. Most supply, service, and rewind electric motors, and look at the most economical and energy efficient solution.

The majority also repair pumps with some operating in confined spaces to remove and refit centrifugal and submersible pumps. Many also service gear boxes. AEMT members work to prevent problems and are probably the largest network nationally and internationally of companies able to carry

out thermography, vibration analysis, and laser alignment. Their mechanical ability to rebuild and refurbish items is legendary. Many AEMT companies are trained to repair and work in Hazardous Areas, and most offer the quality expected with ISO9001.

So when you require help quickly at 1 am in the morning, or 5 pm on a Sunday afternoon, help is at hand! Whether you are in the UK or in Miri in Borneo, just look up the AEMT Website for a list of companies that are able to help you.

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New Year and Fresh Challenges

Welcome to the latest AEMT Journal packed full of interesting articles which continue to promote the excellence of AEMT membership across the world. As I write this, we are still in the throws of Brexit and the position isn't getting any clearer, unfortunately! Whether we actually Brexit, what kind of Brexit we will get, and whether we will even see a change of Government will all become clearer over the next few weeks.



In this time of uncertainty, it is great to see that the AEMT membership still came out in great numbers to attend both the newly launched Conference during the day, on the 29th November, and then the AEMT Awards in the evening, where we were treated to more political distraction with a comedic performance of a look-a-like US President, who was very well received.

The theme for the Conference was "The Circular Economy" and focussed on the importance of our repair and service trade in helping to ensure raw materials and machinery stay in the economy for as long as possible. Recycling and reusing materials are a key aim of building a sustainable future. This is obviously a globally hot topic with climate change being a major concern for all nations. It is good to know that our members more than play their part in helping the planet!

The other key focus of the Conference, further enabling timely service and repair, was the use of digital products and sensors along with the Internet of Things to help deliver timely information on when a machine needs a service. Informative presentations were given from both Siemens and ABB on their approach to incorporating artificial intelligence to help our members provide timely and effective service. It's not without its challenges though

and such technology may also change the relationship between customer, repairers and manufacturers and this was excellently discussed by Si2 partners in the final presentation of the day.

The AEMT Awards thankfully go from strength to strength. Last year we had around 120 attendees and this time that number rose to around 170. The night went very well indeed and was enjoyed by all.

It was great to see how many companies had entered an award category, making the awards very competitive. Congratulations to all the Winners and Finalists on the night, and thanks to all those who attended who made it a special evening. Special congratulations to Andrew Savage of Mid-Kent Electrical who won the AEMT Lifetime Achievement Award. Andrew is someone who has been part of the AEMT for it seems as long as I have been in the industry. I have served on council under Andrew and he has been a great inspiration to all of us in terms of his commitment and dedication to the AEMT and all of its aims. Well done Andrew and well deserved!

So, we now approach 2019 and its hard to fathom how quickly 2018 has gone! The AEMT has had a very good year, event-wise, financially and has also seen

the council grow and all officer positions are now filled and active. This is not to say there isn't place for more input on the council, as there certainly is, but in a time of uncertainty, it is undoubtedly good to see that the association continues to stand up for its members and support them now, and hopefully way into the future. Best of luck for 2019 and I hope to catch up with you at a future AEMT event.

Gary Downes
AEMT Honorary President

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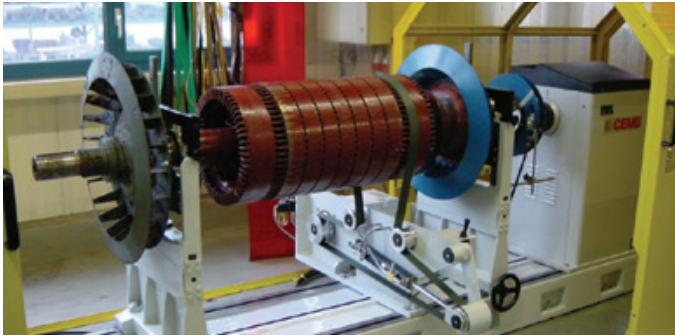
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Ex Course taking place in the UK

AEMT Ex Course to be recognised by IECEx Training Provider Programme

After being scrutinised by the IECEx Recognised Training Partner Programme (RTPP) Review Panel the AEMT Ex Training course for the repair, overhaul and reclamation of hazardous area rotating equipment is now with the IECEx executive who are conducting their final review. It is expected that in January 2019, the course will become the first of its kind to be recognised in the UK and will become the 25th IECEx RTP in the world.

Established in 2016, the IECEx RTPP currently consists of 24 international training organizations offering training courses for all aspects of hazardous area businesses. The AEMT is to become the 25th company recognised by the scheme in January 2019, and is one of very few who covers the repair, overhaul and reclamation aspects of the field.

Dr. Martin Killeen, lead lecturer for the AEMT, has been part of the AEMT Ex courses for over 20 years, giving him an understanding of the content that is second to none.

He comments, "this is a terrific achievement, and bodes very well for the future of the course. In international markets, this will make a big difference as more and more engineers endeavour to complete the IECEx CoPC scheme." All aspects and elements of the IECEx RTPP are defined in the Operational Document

(OD) 521. As with all IECEx documents, this paper can be downloaded 24/7 and free of charge from the IECEx homepage. It contains a framework based on the following elements:

Proposition that an independent and voluntary assessment programme will enable employers to evaluate merits of their staff's training and education.

Adequacy and consistency of Ex training at national and international levels can be ensured.

Assurance that training is being provided with linkages to the latest versions of relevant Ex Rules and Standards.

As an IECEx RTP the AEMT will be able to demonstrate a capability and history of providing training to technical orientated persons in Ex repairs and the IEC 60079 series of standards.

The AEMT offers regular training courses in the UK, South East Asia and the Middle East as well as several other locations across the globe.

Thomas Marks, Secretary of the association, comments, "To be recognised by the IECEx RTP programme compliments the Continual Professional Development (CPD) recognition the course received earlier in 2018. It now means companies looking to train their staff can be confident in knowing they are using one of the very best providers of this training course around the world!"

For more information about the AEMT Ex course on the repair overhaul and reclamation of hazardous area rotating electrical equipment, visit the association's website www.theaemt.com ■



BGA Gear Cutting Course Discount for AEMT Members

British Gear Association offers training to AEMT members

The AEMT has been looking for ways to expand the training offering available to members. Teaming up with the Newcastle based British Gear Association (BGA) means that AEMT members can take advantage of the excellent training courses put together by the association at a reduced rate.

Based on the University of Newcastle upon Tyne's campus, the BGA was formed as a conduit to raise the Power Transmission industry's profile along with the companies and individuals it represents. The BGA is well represented on British and International Standard committees, providing the Chairman of the British Standards Institution's MCE/5 Committee on Gearing and the Chairman to ISO TC60 sub-committee SC1. They are the leading providers of gear related training in the UK.

Courses are well attended within the power transmission industry and the association offers introductory classes to more in-depth specialist training. Most courses are CPD accredited, contributing to an individual's professional development. Additionally, the BGA



was a finalist in the 2018 AEMT Awards category for their Contribution to Skills and Training.

Thomas Marks, secretary to the AEMT explains that, "AEMT members are increasingly handling gearboxes in their mechanical workshops, so having a comprehensive understanding is necessary for them to provide the high-quality service expected from an AEMT service centre."

"Through this partnership, AEMT Member companies will now find it even easier to acquire an understanding of the

design principals and fabrication methods of gearboxes, as well as learning to recognise gear wear and failure."

Courses that AEMT members should be particularly interested in are the Gear Wear & Failure Recognition on the 7th March 2019; Gear Stress Analysis on the 9th & 10th April 2019; Bearings & Condition Monitoring on 24th April 2019; Gear Measurement on 7th & 8th May 2019. A full list of courses can be found in the Events section of the BGA website at www.bga.org.uk.

For 20% off the listed price, members who are interested in attending a BGA course should get in touch with the secretariat on admin@aemt.co.uk



Electrical testing after rewind - credit Sulzer.

IEC 60034-23 – What is it and how does it impact my business?



Dr. Martin Killeen
(AEMT Lead Lecturer
and Technical Consultant)

Dr. Martin Killeen of the AEMT (Association of Electrical and Mechanical Trades) outlines the requirements of the international repair, overhaul and reclamation of rotating equipment standard IEC 60034-23:2018, and highlights how it impacts on both the repair provider and the end user.

The new international standard, which was published in Autumn 2018, is the first to include the requirements of the circular economy, a very important concept that aims to reduce the consumption of resources. Until this point, eco-design, in terms of rotating equipment, had mainly focussed on energy efficiency but now attention has turned to reducing material consumption as well.

Shrinking resources

The majority of rotating equipment is ultimately powered by fossil fuels and our global consumption is continuing to increase. The more industrialised

countries continue to use large amounts of energy, while the developing countries in Asia and Africa are rapidly catching up on our per capita consumption figures.

In terms of global fossil fuel consumption, the figures have increase almost exponentially since the 1950s. As the recovery technology has improved, so we have continued to extract increasing amounts of fossil fuels from the earth.

Based on the known reserves and annual production levels in 2015, we have 114 years' worth of coal remaining, 52.8 years of natural gas and 50.7 years of oil. These figures will continue to change as we

discover new reserves, but they are also affected by the increasing consumption figures. Coupled with this is the scientific prediction of global warming due to CO2 emissions is beginning to increase political pressure.

However, locating new resources and is not addressing the key issue, which is the increasing rate of consumption. With fossil fuels being used in so many aspects of our lives, a long-term strategy is required to tackle this issue and the latest repair standard for rotating equipment is another step in the right direction.



Dr. Martin Killeen presenting at the AEMT Conference.

Setting the standard

The new standard establishes the benchmarks for repairing rotating equipment, maintaining efficiency levels, high standards of quality control and improving efficiency in associated pieces of equipment. The standard does not supersede those pertaining to specialist equipment, such as ATEX, nuclear, aviation, hydrogen cooled and traction, but it does include reference to them and several other standards.

By complying with the new standard, maintenance and repair facilities can prove their quality of workmanship and performance, as well as promoting their commitment to reducing waste and recycling resources. By following the international guidelines, the repaired equipment can be badged with an indicative statement.

By advertising compliance with this standard, companies are promoting their eco credentials, not only in the repair procedures but also in the way that the equipment is tested and proven. Demonstrating procedures that improve efficiency and reduce waste can also act as an effective commercial sales tool as well.

The long-term aim of the standard is to maintain or improve the efficiency of

equipment. It will allow upgrades to be implemented, if they are allowed by the original equipment manufacturer (OEM). This means that the repair workshop needs to be well equipped, with good quality control procedures and staffed by suitably competent employees that are capable of delivering high quality repairs.

The circular economy

This brings us back to the circular economy, which aims to minimise waste through reusing, repairing, refurbishing and recycling existing materials and products. The repair of electrical machines fits in exactly to this concept and by keeping energy efficient equipment operational, we are minimising the use of additional resources.

For some older machines, it may be possible to upgrade their efficiency at the same time as completing a repair. Using modern materials in the rewind and upgrading to a higher-grade insulation e.g. grade B to F, which is much thinner than the legacy component, it is possible to increase the copper content of the windings, making it more efficient by reducing the copper losses and longevity of the motor.

At the same time, any materials that are removed during the repair process, such

as old windings and bearings, can also be recycled, which again minimises the net increase in material consumption. Furthermore, the efficiency analysis will also consider both the repair and the replace options, to ensure that the customer achieves the most cost-effective outcome.

A typical example cited in the standard: To illustrate this further the standard uses the example of a typical 110 kW motor that is need of repair. Approximately 50% of motor failures are attributed to bearings being at fault. Replacing the bearings will double the life of the machine and use 99% of the original machine because bearings are regarded as high quality, green scrap.

In fact, within a typical 110 kW motor, only 0.9% of the materials used to make it are unrecyclable. The steel laminations, iron frame, copper windings, aluminium rotor and the bearings can all be reused – the only waste products are the insulation, varnish and paint.

If the repair involved the machine being rewound, then 90.5% of the materials would be reused. However, the copper and steel being replaced are both high quality, green scrap, so again only 0.9% of the materials cannot be recycled or reused during the repair.



IEC 60034-23 is the first standard to mention the Circular Economy.

Rewind guidelines

The new standard sets out good practice guidelines for various procedures, including the removal of windings using a burn-out oven. The stated maximum temperature for the oven is 370 °C (700 °F) to prevent damage to the steel laminations. However, if ec5 or ec6 steel has been identified, then the temperature can be increased to 400 °C (750 °F).

Further guidance is provided for the orientation of the motor, which should be mounted horizontally in the oven to prevent the chimney effect, which can increase heat above the maximum level. In addition, the temperature profile and the maximum temperature of the oven need to be recorded as part of the documentation for the job.

Once the old windings have been removed, the repairer can install the replacements; if these have been brought in from a third party, it is important to check the specifications to ensure compliance with IEC 60034-23. The insulation grade should match the original or provide an improvement. This is increasingly important for equipment that is supplied with a variable speed drive or frequency inverter, which can cause voltage spikes that would otherwise not be present.

At the same time, the varnish or resin used to encapsulate the windings should

be applied as per the manufacturer's recommendations for curing temperatures. Improvements in resin and insulation material properties will only be realised if the guidelines from the respective manufacturers are followed.

Repairing and rebuilding

In some cases, it may be necessary to rebuild a shaft, but it is important to carry out non-destructive testing (NDT) using penetrant dye or magnetic particle inspection (MPI) before any remedial work is completed. If any cracks are found, they need to be removed before any rebuilding of the shaft is started.

Shafts can be repaired by sleeving, spiral welding and metal spraying. If metal spraying, then a bond test of 40 MPa is recommended. For some specialist equipment, such as Ex motors, bond testing is a requirement that is outlined in the standard specific to the equipment in question. It should be noted that metal spraying is not recommended for peripheral speeds exceeding 90 m/s.

Repairs can also be made to bearing seats, rebuilding them by metal spraying or welding using MIG, TIG, Sub-arc or hot wire processes and the seats should be rebuilt to the manufacturer's tolerances. At the same time, any replaced shafts should have the same magnetic and mechanical properties as the original, but

peening the shafts to improve the fit is not recommended.

Replacement bearings and any grease should be in accordance with the manufacturer's recommendations. These have potential implications for rolling resistance and can impact on efficiency figures. If insulated bearings are installed, they should be tested and the results recorded as part of the repair file.

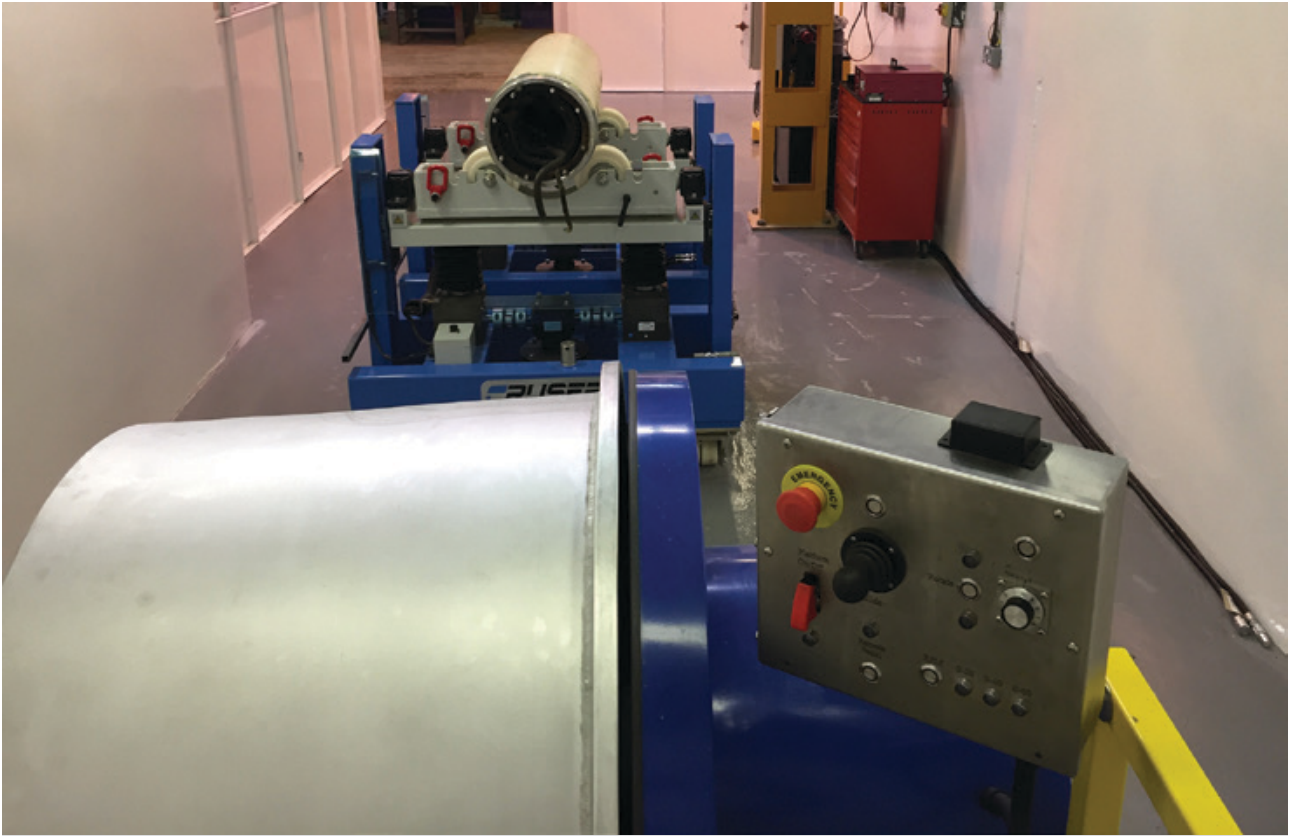
Testing procedures

Although the new standard does cover test procedures, such as insulation resistance, surge comparison, voltage withstand, phase balance, continuity, brush neutrality, and commutator concentricity the details are referenced in their respective standards. These have remained relatively unchanged but repairers should be mindful to cross reference between IEC 60034-23 and the testing standards to ensure full compliance. Test meters and equipment should be calibrated and certified on a regular basis.

For electric motors, there is a requirement to carry out a no load test and a locked rotor test to establish vibration levels and calculate essential data such as the power factor and starting torque. Once again, as with so many parts of this standard the details are referenced to another standard, in this case IEC 60034-1.

In order to achieve compliance with the new standard, most repair workshops will continue with their existing good practice, having invested in suitable facilities and equipment while keeping staff up to date on training. The continued use of a suitable quality control system and repair labels will be maintained, ensuring that any audit of the repair process will result in a glowing report.

As the concept of the circular economy gains greater popularity, so companies that embrace standards such as IEC 60034-23 will be able to promote their active participation. This has the potential to highlight not only the professionalism of the company for repairing rotating equipment, but also demonstrate its commitment to reducing waste and minimising the consumption of resources. ■



Rapid Solutions, an AEMT member based in Baku, Azerbaijan recently added a specialist rewind facility for submersible pump motors within its existing IECEx accredited service facility.

Rapid Solutions facility improved to support Caspian Region Oil and Gas Operations

Rapid Solutions, an AEMT member based in Baku, Azerbaijan recently added a specialist rewind facility for submersible pump motors within its existing IECEx accredited service facility. As a result, it has cut time-to-completion massively and won a prestigious order from one of the Caspian Regions Oil and Gas Industries major operators.

Founded in 1996, Rapid Solutions is an integrated solutions provider of lifecycle services which include: engineering and design, process and pipeline services, automation, electrical, control and instrumentation, safety and fire protection construction, maintenance and support services. Aftermarket services includes the motor maintenance, rewind and repair operation, which offers a wide range of services from a large, dedicated motor services workshop as well as additional

workshops for rotating equipment and valve maintenance and repair services.

Until fairly recently, Rapid Solutions did not have the capability to repair submersible pump motors. Equipment owners had to send these motors back to the UK, adding significant expense and time, as well as introducing additional risks associated with consignments getting lost or damaged during transit.

Due to the sizeable offshore oil and gas

production industry in the region, Rapid Solutions realised that investing in and improving their local capabilities would be beneficial for themselves and the industry in general. Rapid Solutions did some research into the needs of the region and with technical collaboration and support of Hayward Tyler the company which provides similar services in the UK and which also manufactures the specialised equipment which is used to undertake these specialised repairs, it was decided that a relatively large

state-of-the-art facility would be the best option to pursue. Further, it was realised that this could be set up as a dedicated facility within the existing Rapid Solutions rewind centre, a solution that had operational, technical and commercial advantages over a separate building.

The design and layout of the new submersible motors workshop is based on the innovative Hayward Tyler Centre of Excellence in Luton, England. Like its counterpart, the Baku facility is achieving high levels of productivity through the use of ‘Cruser’ trolleys rather than overhead cranes for moving the large motors and associated parts between the workstations.

Overhead cranes are the conventional choice for workshops where large workpieces have to be moved. However a better, safer and lower-cost solution has now been established at Hayward Tyler by transporting the motors on specially-designed trolleys. These have become known as Crusers in memory of a Hayward Tyler colleague who passed away unexpectedly.

Each Cruser is kitted out with fittings and equipment matched to their duty and can carry loads of many tonnes. They are driven and steered by a battery-powered detachable pedestrian-operated tug. As such they are highly manoeuvrable and in use are proving far more flexible, efficient and cost-effective than overhead cranes. As the trolleys may be at each workstation for a considerable time, the tugs can be uncoupled and used elsewhere, sent to recharge or simply stored.

Rapid Solutions also installed a special design of motor winding drum in its new Baku facility which helps speed up the process considerably compared to traditional methods.

With its newly improved facilities, Rapid Solutions quickly secured a contract from the operator to repair wet wound, submersible motors, which are primarily used on offshore oil production platforms to provide sea water for process and fire-fighting duties. The motors range in size from 265 kW to 1100 kW and operate on 690 V or 3,300 V supplies. The motors are used to drive vertical, multi-stage



Rapid Solutions secured a contract from the operator to repair wet wound, submersible motors, which are primarily used on offshore oil production platforms to provide sea water for process and fire-fighting duties.

pumps which are suspended from the oil production platforms. They are critical components since all the water needed by the platform is provided by these pumps. Reliability and availability are therefore of the utmost importance.

SPX Flow, and Hayward Tyler through their technical support and proven submersible motor design is enabling upgrades to the motors to be carried out when requested. ■

Parts used for the repair are provided by the motor OEM, American company



At the 2018 AEMT Awards held on November 28th, the Baku Submersible Centre of Excellence was a finalist for the Project of the Year award.



Copper Windings.

Copper in a circular economy

I had the privilege of speaking at the annual AEMT conference and was fascinated by the discussion around the changing nature of our global economic structure into a circular economy, writes Paul Dewison of MetalsPlus. It is a topic at the top of the global agenda. In fact, replacing the current take-make-dispose model with a circular economy, which aims to design waste out of the system powered by renewable energy sources, was discussed at length during the recent 24th UN Conference on Climate Change.

Copper is at the heart of this global agenda. Research conducted by MetalsPlus on behalf of the International Copper Association (ICA) found that copper is a vital material for achieving a circular economy, with an infinite lifecycle and no end phase. Once mined, it can be recycled over and over with no loss of properties making it ideally suited to a wasteless system. It is intrinsic to the design of efficient electrical systems, thus helping us achieve a circular economy.

The motor industry's drive for efficiency

How does copper help us achieve energy efficiency? Primarily, it is the best conductor of heat and electricity among nonprecious materials, making it essential for efficient power generation

and the delivery of electricity.

The attributes of copper are clearly shown in electric motors. Motor design is being forced to adapt and become more energy efficient. The current energy loss between input and application in motor driven systems stands at 45% (see figure 3). Though much of the loss is from equipment driven by motors rather than the motors themselves, the spotlight still falls on increasing motor efficiency. One reason for this is that motors are typically distinct units that can be targeted more easily by legislation than the diverse array of motor driven systems.

Various options exist for improving motor efficiency. These include the optimization of existing designs, the development of rare earth permanent magnet solutions

(REPM) and other non-PM solutions. Considering the UN's carbon footprint objectives, government regulations now force manufacturers to improve their efficiencies. So now copper's ability to reduce loss comes to the fore. Without fundamental design changes, improved efficiency usually means more copper use, which is why we are likely to see a rapid growth in demand for this special metal.

In 2017 alone, motors and generators accounted for 2.13 million tonnes of copper usage. It is found in all six sectors for motors and generators (Figure 1) – from large industrial motors to tiny motors in hand held domestic appliances. In total, the segment accounts for around 8% of all copper use.

The research recently conducted on

behalf of the International Copper Association found that copper use in motors and generators should grow to 2.73 million tonnes per year by 2022, rising at a rate of 5% a year (Figure 2). This is an acceleration from the 3.6% growth between 2011 and 2017. The automotive sector is expected to show the most rapid growth, driven in part by a growing popularity of electric vehicles, and followed closely by HVACR (Heating Ventilation Air Conditioning and Refrigeration).

Copper a building block in energy transition

Mitigating the effects of climate change is now firmly on the global political and legislative agenda. Not only does current human activity mean rising temperatures, it also means rising sea levels, a more extreme climate, droughts and habitat destruction. CO2 emissions from burning fossil fuel in power generation and road vehicles are the main culprits. Solutions must include generating cleaner electricity, reducing or eliminating road vehicle emissions, and enhancing equipment efficiency to reduce electricity consumption. Copper, it turns out, is intrinsic to all three solutions, and none more so than in motors and generators.

Clean energy generation means the use of renewables – primarily wind and solar. Both are inherently copper intensive, not only in the generators employed in wind farms, but also cables, transformers and other related equipment. For road vehicles, replacing the internal combustion engine with electric traction motors has a direct bearing on copper use, even more so in the lithium-ion battery associated with it. As for energy efficiency, raising motor efficiency by one class, from IE1 to IE2, IE2 to IE3, or IE3 to IE4, can mean an increase in copper use by 20% or more (without a fundamental design change).

Some actions against climate change are market driven, but targets affirmed by the UN COP21 (Paris) Agreement now require government action in legislation as well as by other means. Central to achieving climate change objectives, copper is a major contributor to also achieving a circular economy.

Copper Use by Segment (2017)

Industrial motors also the largest user of copper

Segment	Kt Cu
Automotive	318
HVACR	369
Domestic Appliances	393
Industrial Motors	598
HVACR	242
Domestic Appliances	213

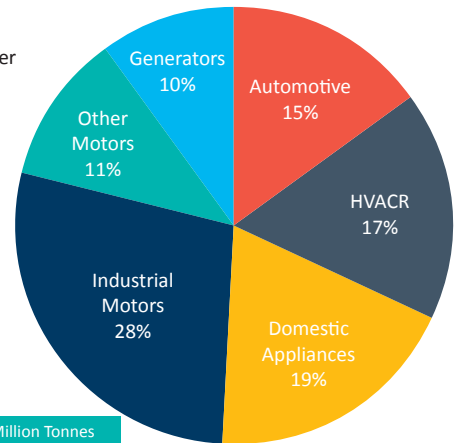


FIG 1

Total = 2.13 Million Tonnes

Motors & Generators Market in 2011-2022

Copper use

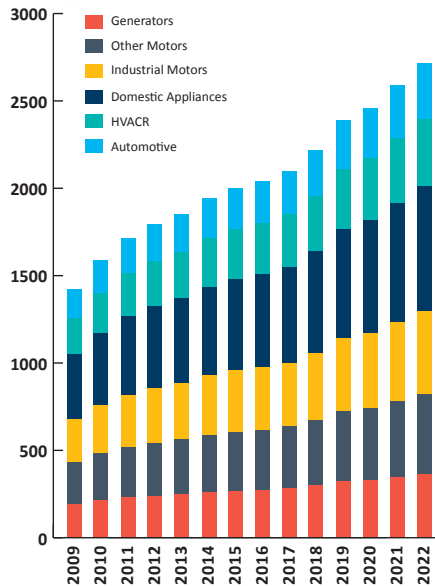


FIG 2

MARKET SUMMARY

	2011	2017	2022	% CAGR	% CAGR
				11-17	17-22
ALL COPPER USE (kt)	1722	2134	2728	3.6%	5.0%

BY END MARKET

	2011	2017	2022	% CAGR	% CAGR
				11-17	17-22
Automotive	237	318	434	5.0%	6.4%
HVACR	302	369	484	3.4%	5.6%
Domestic Appliances	329	393	469	3.0%	3.6%
Industrial Motors	471	598	771	4.1%	5.2%
Other Motors	193	242	302	3.9%	4.5%
Generators	190	213	268	2.0%	4.6%

Copper a cornerstone of the circular economy

The objectives embodied in the circular economy concept are ambitious. The concept centres on the elimination of waste. This is achieved through better design of materials, products, systems and business models. It replaces end-of-life concepts with restoration, seeing the use of new material as ‘leakage’ from what should be a closed system.

Motor efficiency standards are now firmly on the legislative agenda with the IE3 standard now required (or about to be required) across most countries and motor sizes. The reason for the focus on motors is plain to see; they account for

46% of all electricity consumption (see figure 3). Over 40% of the electricity used in motor driven systems is ‘loss’ (i.e. not translated into motive force). To a lesser degree legislation also addresses the efficiency of the equipment incorporating motors, such as air conditioners and pumps.

While legislation to reduce our carbon footprint is important, circular economy legislation has the potential to take the conservation of limited resources to a much higher level. Wide ranging ambitions are evident in the EU Circular Economy Package and to some degree in the China 13th Five Year Plan. To date, the main focus of legislation has been on waste management and the

Carbon Footprint Concern Drives Motor Design

Typically, lowering loss means higher copper use

Motor Electricity Use and Loss in the Electricity Market Context

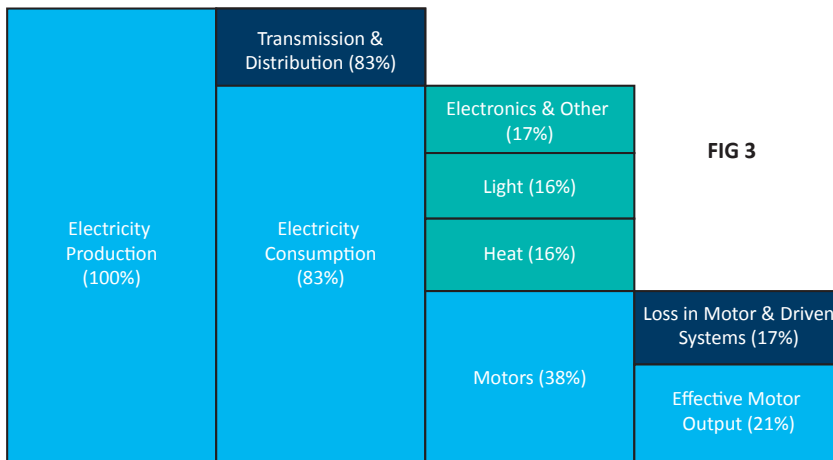


FIG 3

Lower copper use in alternative motor designs applies primarily because a given efficiency can be achieved in a smaller motor, with less stator winding. The winding itself can also be leaner. Most motors have distributed windings, but concentrated windings are gaining share, with a significantly lower use of copper in the windings (up to 50%). The use of more sophisticated electronics makes concentrated windings more viable also.

recycling of materials, but the long-term objective is to go much further. At the production phase this can mean design to minimise material use, the use of low resource impact and recycled materials, and design for repair and long life cycle. Copper should benefit from this development, relative to other materials.

One key attribute of copper is that it is fully recyclable. This, together with the durability of copper-based products, relative ease of repair (shown in the rewinding of motors) and relative low volume of material use, should ensure copper's continued central role in electrical products, especially motors and generators.

Ultimately, of course, full implementation of circular economy objectives will mean a reduction in all material use, including copper, and especially of new rather than recycled material. In motors, we are already seeing a growing penetration of small highly energy efficient motor designs. High energy density permanent magnets have allowed motor size and weight to be reduced by up to 40% compared to traditional AC asynchronous designs. Reluctance motors offer a similar saving of materials, while the copper-intensive copper rotor motor adaptation of traditional AC asynchronous designs also offers a highly efficient alternative for low material usage.

As efficiency levels for motors are ramped up higher, it appears inevitable in the medium to long term that designs that are lean on material use will come to the fore. The materials used will be those that have the best circular economy credentials, so again, copper is set to benefit.

So, from heavy industry and utility motors to smaller applications such as the automotive sector and domestic appliances, copper is a building block for the transition to a low carbon, circular economy. Thanks to its unique properties, it plays an integral part in many of the products we now depend on to reposition the global economy. ■

Paul Dewison:

Paul Dewison of MetalsPlus conducted research on behalf of the International Copper Association (ICA) and was a keynote speaker at the AEMT conference in November 2018.

Paul is a leading base metals industry consultant, focusing on copper, nickel and on their downstream markets. Paul's work ranges from commodity market analysis and forecasting to highly granular analysis of the industries that use metals. Having graduated from Sidney Sussex College, Cambridge University with a degree in Geography, Paul Dewison followed on to work for several of the big names in metals consulting. These included Commodities Research Unit and Brook Hunt (now Woodmac). More recently, having run his own consulting firm Metalica Ltd., Paul moved on to Bloomsbury Minerals Economics (BME) where he ran the copper publications and downstream consulting sides of the business. In 2013 BME's reports and consulting business was bought by Intierra, a business that became a part of SNL Metals & Mining in 2014. At SNL, Paul managed a commodity reports business, initiating the roll out of multi-metals and single metals publications similar to those in copper as well as continuing to work for single clients.



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The Future of the Service Industry: Electric Motor Service Providers

When asked to consider the future it's always good to start in the past. When asked about service it sometimes makes sense to start with products.



Titos Anastassacos
Managing Partner
at Si2 Partners



Most, if not all, car dealers lack the electrical competence to service EVs. Tesla is bringing the work in-house.

things which were previously very expensive suddenly cheap enough to be affordable. This reduction in cost creates massive demand, which, in turn, leads to huge growth rates.

For example, prior to the printing machine, books were written by hand. It took 208 days' worth of average wages to produce a book in the late 14th century. After the printing machine, by the early 17th century, producing a book fell to 0.17 days of average wages, a decline of 1200 times! Demand exploded, and book production went from the hundreds or low thousands a year to the millions and then tens of millions. Books changed the world of course because information could be stored and accessed at scale. Another pivotal product, the light bulb, further increased the demand for books.

At the time of Edison's invention (artificial) light produced by candles and oil lamps was unaffordable for reading purposes for most people. Afterwards however, the cost (in terms of \$/lumen-hour, a standard measurement for light) fell by 400 times. It not only became possible for everybody to afford to read, work and study in the evening or at night. It also enabled schools, hospitals and factories to become more productive, which previously would have been too expensive to light up.

Historically, the light bulb changed the world, in our modern world, so have products like the internet or, particularly, the iPhone (and not necessarily only for

the obvious reasons as we'll see below).

Let's go back to the 1880s. This was the time Tesla's electric motor was introduced, and it too was a pivotal product. At the time, the prime movers in factories and industrial plants were steam engines rotating huge shafts to which all the plant machinery was attached. If the engine broke down all production stopped. Expanding production was difficult, in many cases impossible, and it always had to be in proximity to a coal mine or to a port where coal could be transported.

The electric motor changed all that. Not only was it hugely more energy efficient than steam engines, it was also cheap enough to attach to groups of machines first (group drives) and then to individual machines (unit drives). It reduced the risks of production stoppages, and it enabled the optimisation of factory layouts and new forms of techno-managerial organisation. It also allowed easy expansion of production by adding individual machines, instead of building completely new facilities. In this way the motor made manufacturing far cheaper and more flexible, thereby driving industrialisation.

In the early 1900s utilities started offering motors (inclusive of service) for free to customers who would buy electricity from them. By the 1920s electricity and motors were the dominant drive in a rapidly expanding manufacturing industry. Industrialisation

So, let's first look at "pivotal" products. These are innovations that, as the name implies, induce pivots or radical shifts in direction, in the way the world works. There have been many such products throughout history, most of them recognised after the fact. One was undoubtedly the printing machine, others were the steam engine, the cotton gin or the light bulb. The reason such products create radical disruptive change is that they make

was also supported by two other key ideas. One was interchangeable parts and components through standardisation, so that a part could fit into any number of products. Originally a demand by governments for weapons, it drove the machine tool industry, which produced the necessary machines for manufacturing. The other was the idea of fast repair service and maintenance. Ford's assembly line would not have been possible without it - too much downtime would have killed it. So electric motors, interchangeable parts and fast repair service enabled rapid industrialisation as well as consistently high GDP growth rates - changing the world in the process.

As good as the motor was for the manufacturing industry, it didn't succeed in mobility. Weak battery technology at the time ensured that the electric motor virtually disappeared from vehicles by the early 1930s, replaced by the internal combustion engine (ICE). And the ICE had a great run until it ran afoul of its own success, producing too much local pollution and becoming a major

contributor to global warming.

In 1990, California passed the Zero Emission Vehicle Program which heralded the re-emergence of the electric vehicle (EV), slowly at first, much faster later as other jurisdictions followed suit with regulations. Recent progress in battery technology allows modern passenger EVs to have ranges of over 350 miles at a reasonable cost. It took five years to sell the first one million electric vehicles, but only six months to sell the latest million, and the trend is accelerating. There are close to five million EVs on the roads globally right now. Analysts believe that by 2025 EVs will claim a 15% share (up to 30% in Europe) of new sales and expect up to 150 million EVs on the road by 2030.

The electric motor is therefore making a big comeback. Of the 2.5 billion motors in the world today, roughly 10% are medium sized motors (0.75 – 375 kW) consuming approximately 35% of global electricity production. EVs mean that that number will increase drastically and

quickly. It is no wonder that the funds flowing into electric motor R&D have vastly increased recently to improve not only energy efficiency, but also performance and durability and reduce weight, size and cost. Going further, the first versions of electric trucks, ships and passenger carrying helicopters, even airplanes (experimental) are already in operation. This will have an impact on industrial applications as well. Through the increasingly powerful combination of the electric motor and battery, the industrial and mobility worlds are converging.

While electric vehicles are here, the automotive industry is in many ways not prepared for them. For example, the industry's business model relies mainly on the after-market for its profits, as do the dealer networks. Vehicles with electric powertrains require far less maintenance: They have 80% less moving parts and require no oil and filter checks, and have no radiation fluids, transmission, drive belts, air and fuel filters or spark plugs. A study done in the

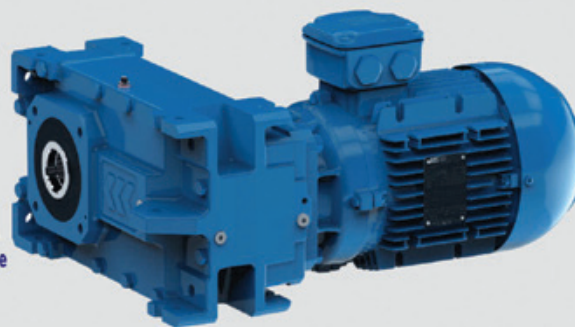


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Prior to the printing machine it took 208 days' to produce a book in the late 14th century. By the early 17th century, producing a book fell to 0.17 days, a decline of 1200 times!

US showed the Tesla Model S to be on average 80% cheaper to maintain than comparable ICE limousines by Mercedes and Ford, when travelling over 600,000 miles. The electric car will significantly disrupt the automotive industry and its distribution/service model. In addition, most, if not all, car dealers lack the electrical competence to service EVs. Resources will not be easy to find, and training will be expensive.

Some forward-thinking OEMs are addressing this issue by eliminating the dealer network altogether. Tesla, for example, is bringing all maintenance in-house (including apparently bodywork) and is in the process of additionally hiring 1400 technicians, deploying 350 service vans (to go to customers to fix their problem) and setting up 100 new service centres in the US alone. Furthermore, it is deploying advanced technology to support remote diagnostics. According

to Elon Musk, the system will be able to place the origin of a problem via a customer's phone through acoustic signalling and triangulation. More OEMs are bound to go down that route, though changing legacy distribution and service structures will be difficult and expensive.

This brings us back to manufacturing and industry. During industrialisation and up to the 1970s and '80s, most B2B manufacturers saw service as a support function, a necessary evil to support the growth of product sales. For example, ABB reportedly set-up its electric motor repair shop network in the 1980s, not because it was particularly interested in service, but because repair, as it was done in the motor factories, was disturbing their production flows.

Many OEMs therefore encouraged and supported the setting up of independent service providers for their products. However, economies matured, growth slowed and in the 1990s companies discovered that installed bases were now much greater than annual product

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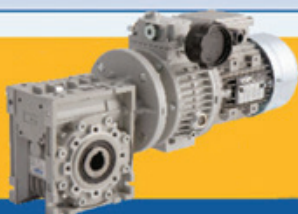
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Rolls Royce power-by-the-hour service means customers pay for thrust, not the equipment.

sales. It was at that time, spurred on also by consultants and academics, that companies started to focus on service, not only as a support for product sales, but as a business and a source of growth.

Initially companies focussed on support logistics to minimise downtimes for customers, as spare parts continue to be a disproportionate contributor to bottom lines. This expanded to knowledge-based support, as it was recognised that it's better to avoid downtimes altogether. Techniques such as condition monitoring (e.g. vibration analysis) became available on computers at the time and were then integrated into automation platforms. Service became strategically more important, to differentiate from competitors, and lock customers in for the longer term.

Some companies created dedicated service business units, operating globally across all brands and products. Many suppliers of large complex systems

expanded their scope outside their own installed base and began to provide service for competitor products. Others moved on to "performance contracting", in effect supplying not the product or system, but rather its utility and taking the risk for the product performing well (according to specifications) far beyond the warranty.

The most well-known example of this is Rolls Royce's "power-by-the-hour" concept for jet engines, where the customer pays for "thrust" rather than the engine with Rolls Royce providing all the support required to ensure that thrust is available where and when required. Such models can now be found in many industries, including power generation, oil and gas, or pulp and paper. Variations can also be found on subsystems or assets within a plant, such as ABB's Total Motor Management. Early in the 2000's, ABB decided to take responsibility for the performance of a customer's entire motor fleet, often

hundreds, even thousands of motors, of all types and brands - against a risk-based fee.

Such contracts certainly risky. It was difficult to accurately assess the probability of failure over long periods, and therefore the cost of repairs and maintenance of the machines. Often companies tried to minimise the risks through exclusion clauses in contracts or high margins. Usually making them unattractive to customers. Condition monitoring was expensive because it required a highly skilled work force for the analysis of every additional customer or additional product.

All this started to change from the 2010s - due to the pivotal product we mentioned at the beginning of this article, the iPhone. Apart from changing communication and photography and creating an addiction for social media, the iPhone enabled and drove miniaturisation, sensing and the

necessity to store, transfer and manage Big (i.e. huge!) Data volumes. It thus set the stage for what we now call the Internet of Things, Analytics, Data Science, Machine Learning and Artificial Intelligence.

These now play an increasingly important role in industry's service and maintenance. Early applications, such as Augmented Reality (AR), can connect experienced service engineers with machine users remotely to help diagnose and rectify problems, significantly reducing waiting and downtimes as well as eliminating travel time and cost. Sensor data can appear in an engineer's field of view overlaying the machine in real time, allowing faster and more accurate diagnostics.

Predictive maintenance through artificial intelligence (AI) or machine-learning can indicate the remaining useful life of equipment, and the probability of failure. Based on the build-up of historic data, the technology allows users to avoid failures and plan for periodic (preventative) maintenance. Effectively, it automates condition monitoring, allowing service vendors to significantly eliminate risk from performance-based contracts, while improving productivity for customers at the same time. Consequently, more and more OEMs are moving into this model of service offering.

There is also another reason. Through its systems, Tesla is currently collecting huge amounts of data on its cars, especially on the performance of its autopilot. It believes this data will help it not only improve its cars, but also give it the edge in the current holy grail of the automotive industry; autonomous vehicles.

Similarly, machine manufacturers recognised the need to stay close to their products after selling them. More specifically to their data: not only may it

help with improvements and innovations, but it may also be that the knowledge acquired through the it, will be more valuable than the machine itself. For example, predicating a maintenance intervention or recognising how to optimise production.

With the advent of EVs and autonomous driving, car dealers will come under pressure from changing OEMs, just as technology will drive competitive behaviour from OEMs in the industrial motor services, therefore putting pressure on independent service providers. Lower prices and loss of business may be the result. Let's not forget that successful predictive maintenance means like-for-like reductions in repair volumes.

Since independent service providers, particularly for electric motors, are commonly smaller local companies, what should they do?

Right now, the emerging changes make for a fuzzy future. Certainly, service providers for electric motors face both challenges and opportunities. On the one hand through the electrification of mobility and on the other the increasing convergence of industrial and automotive technologies. These companies are looking at a greatly expanded market, while at the same time the previous natural players in this market (car dealers) are facing not only declining service volumes (and therefore declining sources of revenue), but also a lack of skills in electro-technologies.

As more and more industrial companies commit to intermittent renewable energies, such as wind and solar power, new asset classes and markets open, including power chargers and energy storage. These can provide opportunities for entrepreneurial service companies to cover the whole ecosystem surrounding the motor, not just the rotating systems. An interesting new market could be

re-purposing batteries from mobile to stationary applications within the context of the circular economy.

The challenges are driven by technology, but technology may also help find solutions: For starters it opens up the ability to share things in multiple ways such as data from entire facilities, standards, expertise, as well as market and sales data. This helps companies to not only get better access to the market, but also improve operations and reduce costs, freeing up resources for investment.

Platform applications, such as Airbnb and Uber are well known from B2C markets, but a number have emerged in B2B markets as well. Crucially, data is the key opportunity, not so much for individual service companies, but for companies acting together collaboratively.

Collectively, small independent service providers hold more data collectively than individual OEMs, even the big ones! Including data on plant machinery, types of facility, brands of motors, other assets, and operating conditions. This collective data may prove very valuable, whether monetised through direct sales to data brokers or used elsewhere. The data could be used to develop predictive maintenance applications or, more importantly, something new altogether. Future applications will help improve customer operations, de-risk contracts, and improve company sales and margins.

It won't be easy to do and it will require significant collaboration and discipline by companies that are perhaps not so used to operating in this way. It is possible though, and it could well be worth it. Collaborating to compete may well turn out to be the right way for the future of this service business and will probably open up exciting new business concepts made possible by those astonishing pivotal products: the internet and the smartphone. ■



Titos Anastassacos:

Titos Anastassacos is Managing Partner at Si2 Partners, a boutique consultancy focused on helping clients leverage services to win in industrial markets. He also runs the Service in Industry Hub a blog/magazine and network for Service Leaders.



Precision engineering is required to prolong reliability and effectiveness.

Optimizing pump reliability and performance

The offshore industry faces two main challenges: maximizing production within the limits of the reservoir, and minimizing operational costs while maintaining the safety of the platform. Pumps form one of the main groups of equipment that influence the outcome of both challenges and they require expert knowledge to ensure continued reliability and performance.



Murray Wilson of Sulzer UK argues that in each case, industry engineering expertise and commercial innovation are required to deliver these goals. Furthermore, the capital expenditure to improve reliability is most often far outweighed by the costs incurred by an unexpected failure and the subsequent costs of lost production. By taking a proactive approach and involving an expert maintenance provider, platform operators can deliver significant benefits to the business in the long term.

Improving performance

In the years following commissioning, the actual duty requirements of production pumps are likely to change - production rates may start to decline after the initial plateau period or the connection of additional wells may mean that potential production is being limited by the processing trains which were designed for lower volumes.

As equipment is pushed to operate significantly outside of its original design envelope, this can often cause operating problems which impact reliability and ultimately affect platform production. This also results in increased maintenance costs as operators and equipment specialists are required to overhaul plant more frequently.

Ultimately, the goal is to improve reliability and efficiency while reducing downtime and energy consumption, at the same time satisfying API, ATEX, and many other engineering standards. However, this seemingly impossible task can be achieved through the implementation of preventative maintenance techniques and the adoption of the latest engineering designs for pumps.

Water injection pumps, seawater lift pumps, crude oil offloading pumps and fire suppression systems all require individual designs to deliver the best efficiency and productivity. At the same time, they also need specialist maintenance routines that will prolong reliability and effectiveness.

Proactive maintenance

A proactive maintenance regime is crucial to identifying potential issues before they develop into problems. However, this requires knowledgeable and experienced personnel to carry out the in-situ platform maintenance and these skills take time to perfect. The time required for this process can be greatly reduced by instigating a training program prepared by experts in equipment maintenance, who can pass on their collective knowledge in a structured and efficient manner.

In terms of through-life maintenance cost, preventative action is almost

always less costly than corrective action, and adopting a carefully managed, proactive regime is crucial to identifying potential issues before they develop into problems. Two of the most prominent symptoms that occur prior to failure in mechanical and electrical equipment are increasing vibration and rising operational temperature.

Regular trending can prove invaluable through the analysis of radial and axial vibration signatures and thermographic / visual inspections of bearings, coils and electrical connections. The latest developments in operational monitoring can be applied to existing assets and then used to determine the optimal point at which planned maintenance should be conducted.

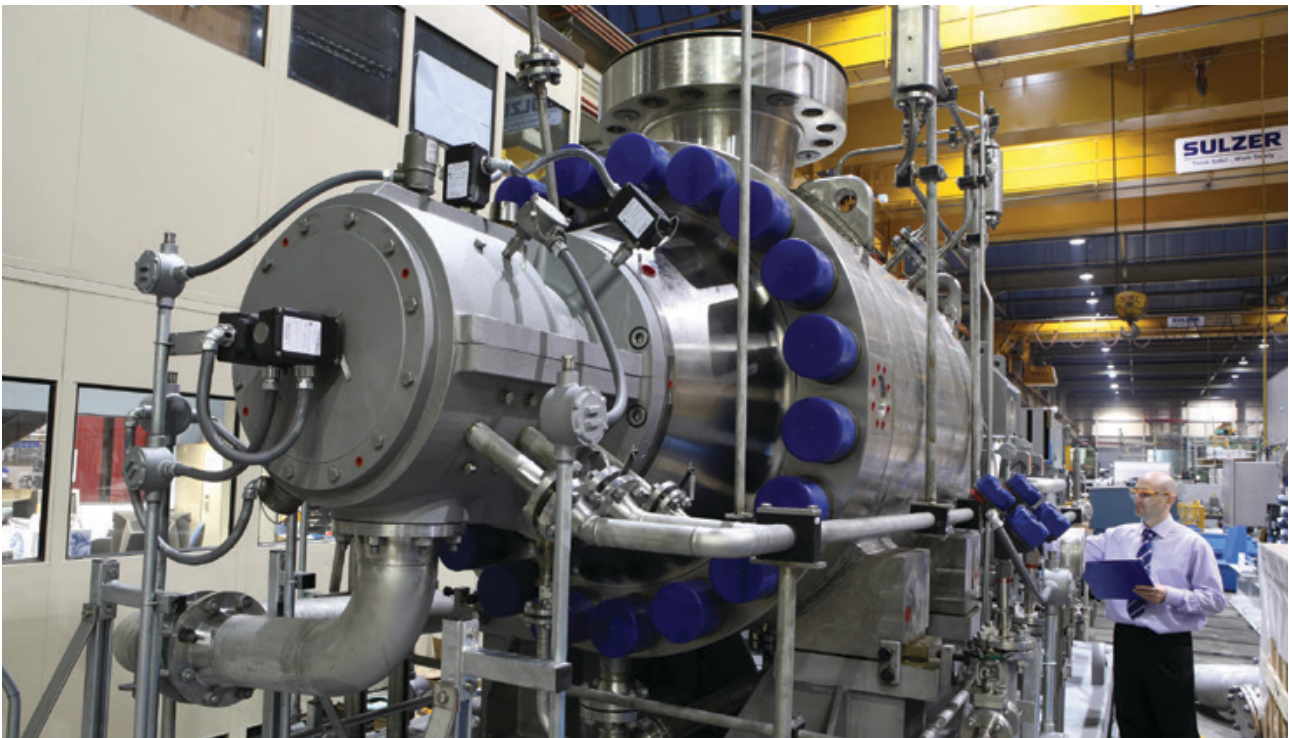
Understanding cavitation

Most commonly seen on the pump impeller, cavitation is caused by a pressure difference, either on the pump body or the impeller. A sudden pressure drop in the fluid causes the liquid to flash to vapor when the local pressure falls below the saturation pressure for the fluid being pumped. Any vapor bubbles formed by the pressure drop are swept along the impeller vanes by the flow of the fluid. When the bubbles enter a region where the local pressure is greater than saturation pressure, the vapor bubbles abruptly collapse, creating a shockwave that, over time, can cause significant damage to the impeller vanes or pump housing.

In most cases it is better to prevent cavitation rather than trying to reduce the effects on the pumping equipment. This is normally achieved by one of the three actions:

Increase the suction head

Lower the fluid temperature
Decrease the Net Positive Suction Head Required (NPSHR) For situations where cavitation is unavoidable, or the pumping system suffers from internal recirculation or excessive turbulence, it may be necessary to review the pump design or minimize the potential for damage using a bespoke coating system.



OEMs are an excellent source of engineering expertise.

Tackling erosion

The offshore production environment exposes pumps to harsh operating conditions. The abrasive nature of the fluids being pumped in certain processes on board can ultimately result in reduced efficiency and decreased pump performance.

Produced Water Re-injection pumps, which are employed to force water back into the oil field and thus maintain the reservoir pressure needed to lift the oil to the surface, are often subjected to high levels of abrasion. This is commonly the result of sand carryover from upstream filtration, where there has been a process upset, or where filtration systems are not adequate. The pumps used to transfer these fluids can experience significant levels of erosion, especially in areas with high flow velocities. The entrained sand particles act as an abrasive and higher working pressures only serve to compound the issue.

Pump manufacturers will aim to minimize flow velocities throughout the pump. They design it in such a way that the fluid flowing through tight clearances are as low as practically possible, and within the duty for which the product has been designed. Under these circumstances, one of the most effective solutions is the use of specialist protective coatings,

which can be used to protect selected areas in the pump.

Delivering the best coating system

With so many benefits arising from a specialist coating, it is important to determine the most appropriate materials, equipment and application procedures, otherwise the coating may degrade and fail prematurely. The processes and specifications used by companies such as Sulzer for applying coatings have been developed over many years. They are essential to delivering a durable and reliable product.

To illustrate the importance of these procedures, especially in pump applications, consider the process of installing and removing an impeller. In many situations, the impeller is heated to allow it to be installed or removed from the drive shaft. This shrink-fit procedure can cause inappropriate coatings to be damaged during a routine maintenance operation. Sulzer has ensured that its coating technologies can withstand this thermal shock and continue to deliver long-lasting corrosion protection.

The importance of engineering expertise should not be underestimated and the benefits of engaging an experienced and well-resourced pump engineering

company should not be overlooked.

When dealing with complex engineering design, as seen in many pumping applications, it is very important to select the most effective and efficient resources to deliver a repair or refurbishment.

Meeting the logistical challenge

When it comes to complex equipment such as the large pumps encountered on offshore platforms, the most efficient delivery of maintenance will come from a provider of turnkey rotating equipment solutions. These organizations should have the necessary service facilities, trained & competent staff, logistical support and the service culture needed to support production critical plant.

In an ideal world, all the maintenance would be carefully planned and managed, but often it is necessary to respond to a situation immediately and deliver technical support, equipment and materials at a moment's notice.

Sulzer offers state-of-the-art design and manufacturing facilities for oil and gas production, including subsea applications. This expertise is transferred throughout the company and used to support the maintenance and repair of any type of pumping asset. ■



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One of the flexible manufacturing areas for electronic components

Camis offers specialist expertise and knowledge in motors and electronics

With an ongoing campaign to promote manufacturing in the Midlands, Camis offers diverse expertise and manufacturing capabilities from its base in Kingswinford. The motors and drives division is a leading distributor of specialist AC and DC electric motors while the electronics division offers design and sub-contract manufacturing for wiring looms, circuit boards and controls for a wide range of industrial applications.



Thomas Marks
(AEMT Secretary)

Thomas Marks, AEMT Secretary, looks at this remarkable member company and how its expertise is helping so many other manufacturers and businesses

Across the world electric motors deliver essential power to millions of processes and applications, from the smallest DC servo motor to massive high voltage, multi-megawatt motors on oil and gas platforms. In every case, selecting the

most appropriate motor will have a significant impact on performance and reliability.

Camis Motors & Drives has several well-established relationships with principal

manufacturers such as Winkelmann, Emod, Omece and Kaiser Morten. These enable the company to offer specialist motors for hazardous areas such as oil & gas platforms, mining applications and the marine sector.

Sarah Rowland, Key Account Manager at Camis explains: “Those involved in specialist applications know exactly what specifications and certifications are required for their motors; our task is to select the most appropriate product and ensure it is delivered on time. Our understanding of these applications and the importance of reliability and performance are major benefits to our customers.”

Camis Motors & Drives also works with OEMs to ensure their products deliver the dependability that is required. For example, a gas fired turbine requires a continuous lubrication supply for smooth operation. So, if the electrical supply to the plant - and hence the lubrication pump motors - is lost, there is a risk of significant damage to the gas turbine.

The solution is a back-up motor that can be powered by an emergency battery supply and brought online within seconds. The challenge is for the motor to deliver 100 percent reliability in the unlikely event that it is required; the cost of failure is not just the price of the repairs to the turbine, but also the loss of

revenue from the generator that remains offline during the repairs.

Similarly, there are other applications in power stations that require critical service protection, such as flood pumps that need to operate underwater during a power outage. Camis is able to source IP68, DC motors that are capable of delivering this vital service and ensure that a temporary loss of power has no lasting effect on the plant.

For those with equipment operating in potentially explosive atmospheres, there is a considerable amount of certification that must be complied with to ensure a safe working environment. Typically, the specification list for a motor for the offshore industry can be extensive – aside from the regulatory standards for flameproof or explosion proof design, the type of paint, various supply options and suitability for tropical climates can all add to the challenge of finding exactly the right motor.

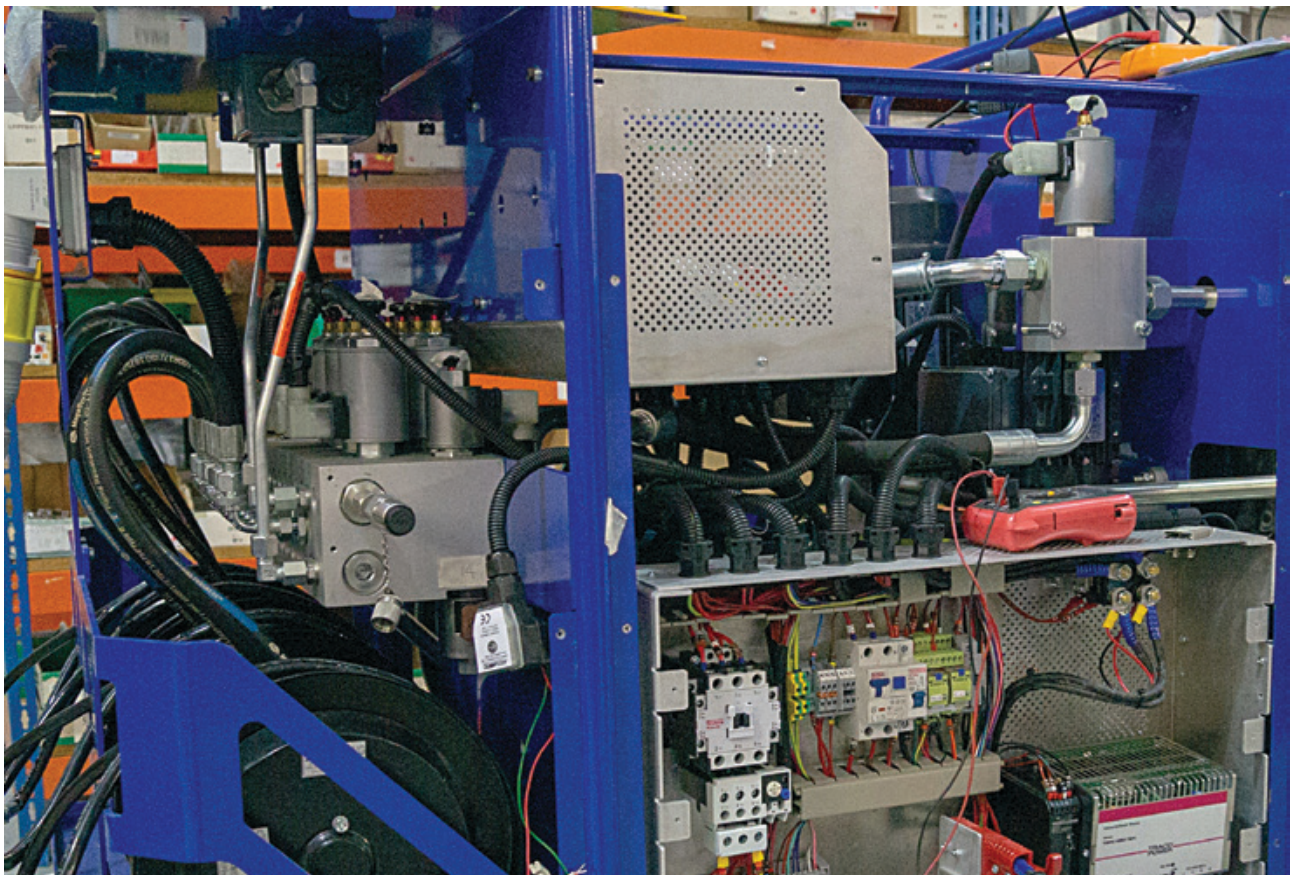
Camis also offers considerable expertise in DC motors, especially when it comes to creating a new installation. One of the

most important aspects of a design is matching the resistors to the motors to ensure continued reliability in service. Camis can create a ‘plug & play’ cabinet that incorporates all of the required control circuits as well as matched resistors to provide the optimum solution.

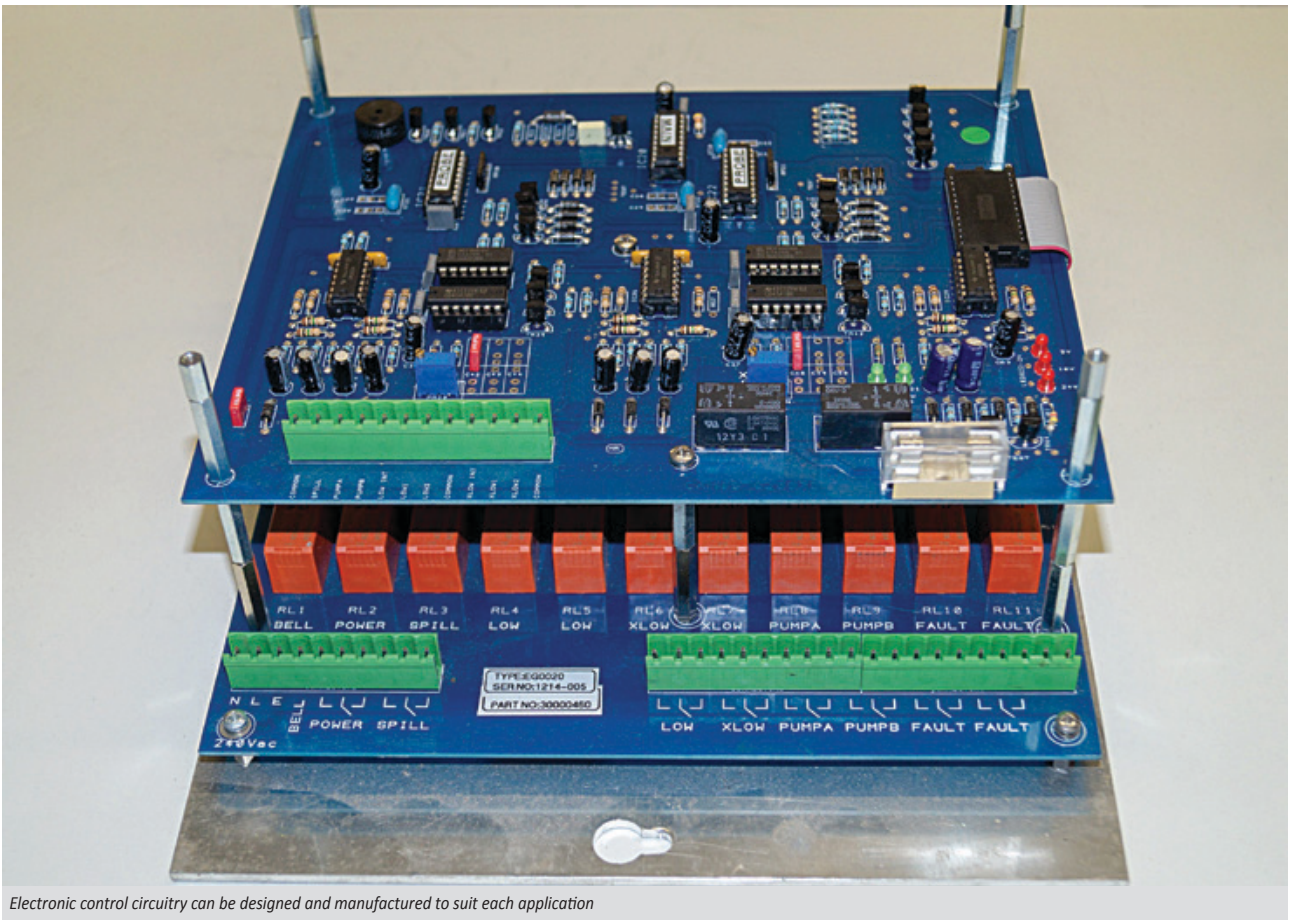
Electronics and wiring

Camis Electronics is a leading manufacturer and distributor of engineering solutions, especially electronics products and wiring solutions. The company has its own in-house design expertise and engineering knowledge, capable of delivering mass-produced items as well as tailor-made, one-off concepts.

At the heart of this division is the cable assembly and loom business, which offers design and sub-contract manufacturing. From the simplest single wire and connector to complex wiring looms and electronic control systems, Camis delivers high quality products on short lead times.



Hydraulic and electrical controls for a bespoke hydraulic filtration unit



Electronic control circuitry can be designed and manufactured to suit each application



Bespoke control systems are designed, built and tested for OEMs

Primarily working with the off-highway sector, security and catering equipment as well as water treatment plants and materials handling applications, Camis offers flexible manufacturing facilities that can be applied to a wide range of electrical and electronic challenges.

Rob Burrows, technical manager, explains: “We work closely with our customers to develop exactly the right solution for their product. From custom circuit boards to

building in-house test rigs for optimum quality control, we ensure that every aspect of the design is delivered on time.

“Our state-of-the-art equipment ensures that every wire is cut, stripped, twisted, ferruled, crimped and labelled perfectly every time. We appreciate that our products have to work faultlessly with many others that are connected to them, to ensure reliable operation of the OEMs equipment.”

Camis also designs and manufactures wiring looms and electronic controls, such as joysticks for the off-highway sector. As a distributor for several major component manufacturers, such as Pepperl & Fuchs, Crouzet, Johnson Electric and Saia Burgess, Camis also offers cost-effective control solutions.

By working closely with OEMs, the design engineers can quickly develop a concept into a prototype and, after successful testing, full production. With capacity to deliver 40,000 looms per year, the production area has the flexibility to ensure delivery deadlines are met, with every loom being quality checked and tested before dispatch to the customer. Accident prevention product

One example of the company’s capability is a project to create a warning system for HGV drivers to ensure that their trailers are correctly coupled before they drive off. With so many products delivered by articulated lorries, drivers are repeatedly required to drop off one trailer and connect up to another. This is not just at the distribution hubs, but at ports and logistics centres around the country.

Each time a trailer is coupled to the tractor unit, the king pin must be securely located in the fifth wheel and held in place by the locking bar. If, for any reason, this procedure is not completed correctly, there is a risk of the trailer dropping to the ground when the tractor unit pulls away. This can cause significant delays in delivery of the goods as well as serious damage to the trailer itself.

Camis has been working with an OEM to develop an in-cab warning system for the driver to alert them to any part of the procedure that has not been completed correctly. The system involves a number of sensors, a basic processor and a warning light located in the cab.

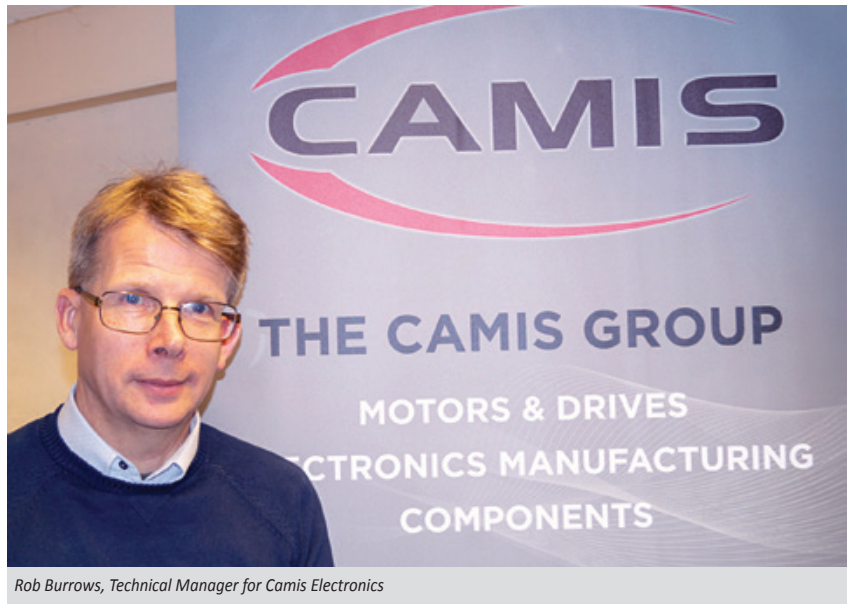
Having completed testing of the prototype system, Camis has created a production test rig that is being used to ensure perfect operation of every product. Today, orders are placed by the OEM for delivery to coincide with their build schedule.

Hydraulic maintenance system

On a slightly larger scale, Camis was approached to see if it could create a system for cleaning the hydraulic oil from a tram. The operators were looking for a new piece of equipment that could reduce the time to half a day required to complete periodic maintenance, which currently stands at five days.

The design brief asked for a mobile cleaning station that could evacuate the hydraulic system of the tram, clean the oil using filtration to a level of microns, check for cleanliness using laser refraction and then refill the hydraulic system. This process was to be repeated until all of the contamination has been removed from the hydraulic system. Timings were agreed with the tram operator and once the concept and the processes were signed-off, Camis' design engineers started with component selection and designing the mobile cart that would accommodate all of the equipment.

The design uses a series of both AC and DC motors to power hydraulic pumps, all controlled through an HMI and a number of contactors. The development process has taken a few months, but it is



Rob Burrows, Technical Manager for Camis Electronics

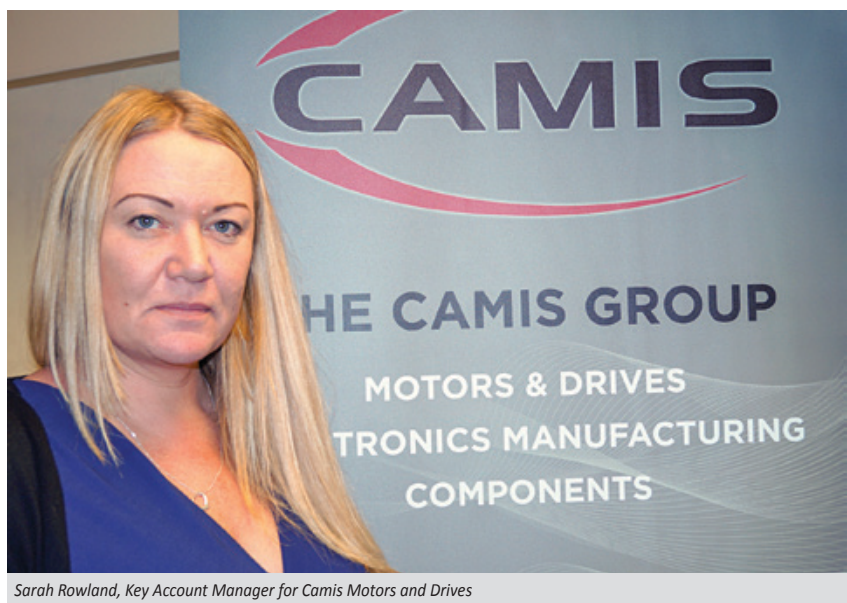
now coming to a close. The expectation is that the new hydraulic maintenance station will enable the oil cleaning process to be completed within half an hour, a considerable improvement on the current time.

Rob Burrows concludes: "Having created the first unit of its type, we are looking at other applications for a similar maintenance trolley, such as dockside forklift trucks. Any machine that uses hydraulics can suffer from contaminated oil, which can cause premature wear in pumps and damage seals.

"Just changing the oil is not the solution, much of the contamination will remain in the hydraulic tank and still cause

problems. By repeatedly cycling the oil through the cleaning system, the vast majority of the debris is removed. By minimising the time required to complete this process, we are reducing machine downtime and cutting maintenance costs."

Camis brings together a unique combination of expertise and knowledge that can be applied to a wide variety of applications. From specialist electric motors and controls to bespoke electronics and wiring looms, Camis has the breadth of understanding that is needed to ensure a successful project.



Sarah Rowland, Key Account Manager for Camis Motors and Drives



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Sidrive IQ digital platform: Optimized performance into the megawatt range

Sidrive IQ improves drive systems along the entire life cycle up to the megawatt range. Cloud-based application based on networked drive systems from Siemens. Increased productivity, reliability and ease of maintenance.

Sidrive IQ from Siemens provides a digital platform enabling the evaluation and utilization of data gathered from drive systems. On the basis of networked drive systems from Siemens, this cloud-based application is now also available for motors and converters in the medium and high-voltage range.

This opens up an array of benefits for plant and machine operators, from optimized maintenance activity and maximum availability to increased productivity, from low outputs through to the megawatt range across the

entire life cycle. Connectivity modules such as Simotics Connect 400 collect motor condition data and transfer it to the Sidrive IQ platform via WLAN. With the latest generation of its Remote Services and Condition Monitoring Services offered as part of the Sidrive IQ Services portfolio, Siemens is making available corrective measures for fixing faults, preventive maintenance offers and proactive services for optimized performance. The optimized drive systems are used in pumps, fans and compressors across different sectors of industry such as oil and gas, mining, food

and beverage, water and wastewater, metals and cement.

With Sidrive IQ, Siemens is offering a digital platform for the evaluation and utilization of drive data based on MindSphere, the IoT operating system. At this year's AEMT Conference, Dr. Christian Mundo, Head of Digital Office at Siemens Process Industries and Drives presented the Sidrive IQ digital platform as part of an overall view of the Digital Twin service offering by Siemens.

The interaction between operating data and digital twins provides plant and machine operators with a vast array of available data via Sidrive IQ – from measured values, status and operating KPIs, service messages, location positioning and technical product data to spare part information.

Siemens has harnessed the advances achieved in the Internet of Things (IoT), sensor technology, cloud computing, analytics, domain competence and cyber security to enable these innovations along the entire value chain. The upgraded version now also allows the simple, standardized connection of high-voltage motors such as Simotics HV C and medium-voltage converters such as Sinamics GM150 or Sinamics Perfect Harmony GH180 to Sidrive IQ. This requires the use of the Sinamics Connect 500 or Simotics Connect 600 connectivity modules.

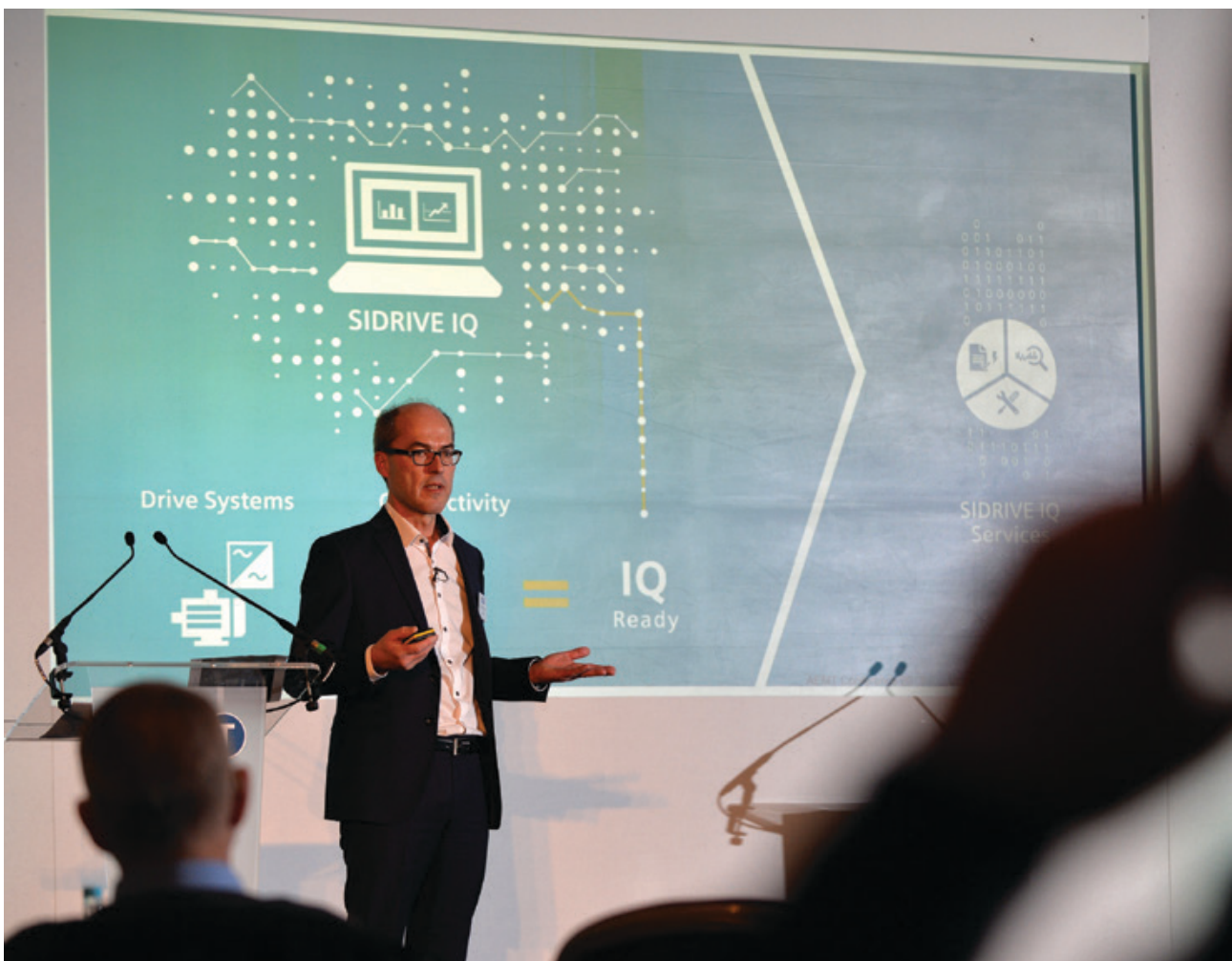
Customized digital expert support with Sidrive IQ services

Digital Check enables customers to benefit from a digital concept tailored precisely to their requirements. Based on this concept, Connect Package combines all the services required for the implementation of a digital infrastructure. Expert Assistance and Expert Diagnostics are new features added for the medium and high-voltage ranges, which enable Siemens to now offer cloud-based and expert-based data analysis. With the aid of Expert Diagnostics, service experts are able to continuously monitor connected components and so minimize unscheduled downtimes. If any vulnerability is detected in the drive system, a direct and comprehensive notification is sent to the customer. Expert reports are also drawn up containing a detailed condition assessment and service recommendations. If an unforeseen error occurs, Siemens also offers scope

for direct remote support with its Expert Assistance service. In this event, the expert team is automatically informed over MindSphere, the cloud-based open Internet of Things (IoT) operating system from Siemens, and gets in touch with the customer to fix the fault as quickly as possible.

Setting standards with Industry 4.0

The spread of digitalization and the resulting networking of data flows are driving increased demand for IoT and cloud solutions. To meet this growing demand, Siemens is upgrading all the key components of its portfolio with digital functions to improve product performance and enable new business models and services. With the development of its Sidrive IQ digital platform for converters and motors, Siemens is fulfilling these requirements and helping improve availability, at the same time enhancing production efficiency and ultimately also productivity. ■



Dr. Christian Mundo presents the Digital Twin at the AEMT Conference



Exposing Counterfeit Bearings with NTN

Globally, product counterfeiting is on the increase; the EU estimates that fake goods costs the UK economy £30m and 14,800 jobs. Not just in consumer goods such as music, film, home electronics and designer clothing, but also in industrial, safety critical products such as bearings.

In China, there has even been an explosion for shanzhai (fake) products, fuelling the problem. In some markets, counterfeiters' have even been known to produce a product the brand they are copying doesn't even make. A good example of this is the iPad mini, which counterfeiters produced a year before Apple even had.

What may be considered by some as an activity that "happens elsewhere", is a growing problem in Europe as global trade has become easier, and shipping costs from all over the world have become more acceptable.

Mark James from PwC's anti-counterfeiting team notes, "Ultimately, companies are seeing their brand, reputation and revenues stolen".

As bearings are widely used in many fields, they are a prime target for counterfeiters, and by copying the trademark of a leading manufacturer, they can greatly raise the perceived value of their product and therefore their selling price.

As the internet has flourished, so have the opportunities (and risks) for purchasers to buy bearings from non-authorised sources.

Risky business

Counterfeiting presents significant risks to the user. Safety is the number one reason for buying a genuine bearing. While counterfeiters are good 'copy-cat' manufacturers, their ability to reproduce the advanced metal technologies, lubrication and finishes in genuine bearings is minimal. A faulty bearing can have devastating consequences. In a pumping station, severe flooding could cost people's lives and ruin ecosystems; or in the utilities sector, outages can create hazardous environments and cost the economy. In transport, a faulty bearing can cause havoc on the rail network, motorways, or at its worst, bring down a passenger plane from the sky.

Ensuring the bearing is not a fake provides the user with 3 key assurances:

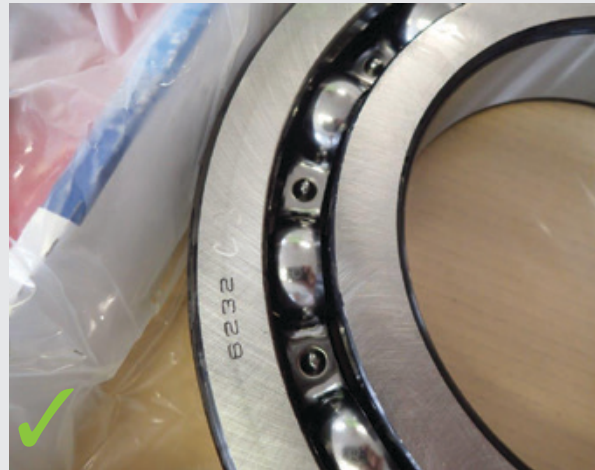
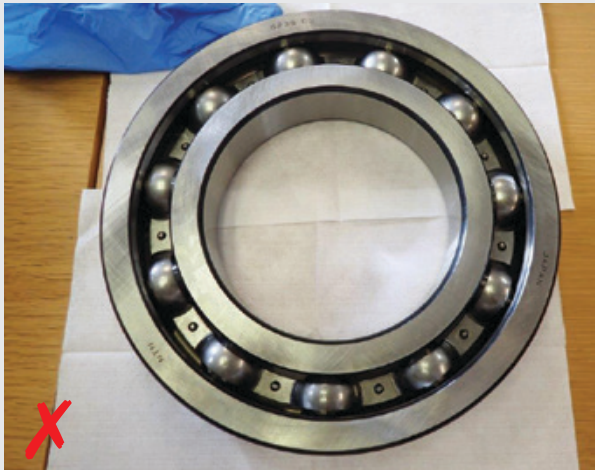
Safety: as we've seen, counterfeit bearings jeopardize safety, and therefore the life of people and products.

Availability: counterfeit bearings can cause breakdowns resulting in a loss of production and profitability.

Reliability: counterfeit bearings do not have the expected quality level and are

likely to fail, degrade your equipment and shorten its service life. They will be repaired or replaced more frequently and therefore significantly increase the costs, expenses, and workload associated with them.

In turn, the financial impact fakes have on premium bearing manufacturers means investments dedicated to innovation are otherwise spent on counter measures to the counterfeiters. In addition, counterfeiters sell old technology, meaning lower efficiencies and reliability, in turn tarnishing the reputation of the manufacturer's brand. The risk to the purchaser of the counterfeit product, also comes with its own array of penalties. As a reliable service centre, quality will be in the heart of every machine leaving the workshop. When a fake bearing is used, the company's reputation can be tarnished, and accused of being 'cheap' for using sub-quality products, in the worst case, it could lead to claims for damages or injuries caused by failure. So, learning to spot a counterfeit bearing is beneficial many times over.



3 tips to identify a genuine product:

1. Always buy through authorized sources who purchase the product directly from the manufacturer.
 2. Request an invoice with all the legal information. This will aid traceability in the event of a dispute.
 3. Beware of those “too good to be true” prices that are below market value and have unusually high availability. There has been an increase in more sophisticated pricing just below market value, but with a large enough margin to raise suspicion.
- If in doubt contact Michael Wooldridge, Head of Industrial Aftermarket on michael.wooldridge@ntn-europe.com or call 0044 (0)7795 037883 for help and advice.

Spotting a fake

In July 2018 NTN, an associate member of the AEMT, received a bearing from a member, suspicious of its authenticity. As a standard procedure, the bearing should be sent directly to NTN, 11 Wellington Cres, Fradley Park, Lichfield WS13 8RZ. Once received, the bearing was inspected by the team and 4 key tell-tale signs of a counterfeit were spotted:

1. Irregular packaging also showed a copy of an outdated NTN logo.
2. Identity markings etched on to the bearing was not in keeping with NTN method.
3. Raceways were not super finished, meaning the bearing would give a poor performance and service life.
4. Cage retainer was poorly finished.

Usually the bearing is destroyed, however this one was kept as an example for demonstration purposes. At an AEMT meeting in September, members were presented with both a fake and a genuine bearing and asked to tell the difference. It wasn't easy! Some got it right, but others mistook the fake for the genuine article. As handlers of bearings every day, one might assume it would be easy for a fake to be spotted by the trained eye of an AEMT service centre employee. Clearly, though, the copies are so good that they

can easily fool the most experienced among us!

As an active member of the World Bearings Association (WBA) NTN are committed to combating counterfeiters. Established in 2006, the WBA and its participating companies assist local law enforcement with information and identification of counterfeits, to help find and prosecute counterfeiters. Together they promote the common, lawful interests of the world bearing industry, and have committed themselves to a series of actions:

- To raising awareness among industrial manufacturers, distributors, and professional associations of the risks.
- Training of customs staff, distributors and original equipment manufacturers (OEMs), to identify counterfeit bearings.
- Constant innovation to develop improved products that are not easily counterfeit.
- Issuing accreditations to endorse businesses as reliable suppliers to the market.
- Using sophisticated identification markings to suppress counterfeiting.

In 2017, NTN introduced a new anti-counterfeit label and app using three ways

for a customer to authenticate an NTN bearing:

1. White micro-characters repeating the name “NTN” can be seen on the label’s blue band with a magnifying glass. On authentic NTN bearings, these characters should appear sharply outlined and distinct.
2. Blue micro-characters, which cannot be seen with the naked eye, are randomly placed among the blue circles on the section of the label with the white background. On genuine NTN products, these letters are sharply outlined and distinct.
3. A hologram, with diagonally-placed strips containing the letters “NTN” running continuously along the strips, appears on one edge of the label. On genuine NTN products, these letters change from black to white, and vice versa, when the label is tilted ninety degrees.

Additionally, NTN has developed the “AuthentiBear” app that assists purchasers to determine, by scanning a QR code, if bearings are genuine NTN bearings. The app may be downloaded from the App Store or Google Play. ■



Gary Downes, AEMT President, welcomes delegates to the Conference.

The 2018 AEMT Conference & Awards

Hosted at the DoubleTree Hilton in Coventry, the AEMT Conference was relaunched with fantastic success, and looked at how service and repair centres can prepare themselves for the imminent changes to the market sector by taking advantage of the Circular Economy. In the evening the AEMT hosted its largest event yet, it's second Award Ceremony, which ended the day with an electrifying celebration of the industry's finest talent, and presidential entertainment from Mike Osman.

As member's started to fill out the main hall of the DoubleTree by Hilton hotel, the buzz of chit chat and networking quickly built up. Display stands lined the room with coffee and refreshments close at hand to stimulate conversation. Among the display partners were a mix of associate members, full members, business support partners and prospective members to the association.

The guest list was a healthy balance of members, associates and non-members, and we're proud to say the day was the most attended of all AEMT conferences to date! A balance of keynote talks, and business workshops worked well, and will follow through to next year. However,

the feedback strongly suggested that we breakup the day more, so that there are opportunities to visit both the keynote talks and the workshops. With more new faces than ever before, it was also noted that networking was becoming ever more important; the ability to 'connect' with fellow delegates will be another feature looked at for next year's conference.

The association's president, Gary Downes, opened the conference by welcoming delegates, and thanking all those who brought the day together, including the display partners. Thomas Marks, Secretary of the AEMT, took to the stage to familiarise members to the Circular Economy and introduce the line-

up of speakers who went on to inform members of the various economic, technological and legislative changes due to change the industry in the coming years.

The Circular Economy, simply put, is an economic framework that is restorative and regenerative by design. The less energy required to keep materials out of the ground, the more sustainable the design. Taking electric motors as an example, they are almost entirely made from easily recyclable materials. Further still, AEMT members are primed to make the most of the service market for this equipment and all extending plant.

Talks followed starting with the International Copper Alliance, who looked at the growing demand for copper in motors and generators, as covered in the supporting article earlier in this edition of the Journal. Then, AEMT's Dr. Martin Killeen introduced the new IEC 60034-23 repair standard for rotating electrical equipment. Siemens Dr. Christian Mundo spoke about the Digital Twin and the company's new Sidrive IQ software launched for digital drive systems, also covered in the supporting article. ABB's Steve Hughes entertained with a look at the ABB Ability electromechanical drivetrain system, as was covered in the 18-2 edition of the AEMT Journal.

Topping off the conference, a guest visit from Si2 Partners' Titos Anastassacos took delegates on a journey from past to future looking at the pivotal products that have changed our world. Not least the electric motor, the smartphone, and the internet – now all combining to

take the service industry into a new age altogether. Titos's supporting article is also found in this edition of the Journal.

Heading upstairs one floor to the conference floor to the breakout sessions, AEMT's Event Organiser, Samantha Agnew, hosted delegates for a more business focused series of seminars. Gary Sheader of the Manufacturer's Alliance discussed the top challenges for ambitious leaders. Clive Reddihough of FMS should be known to those who attended the association's southern meeting in Chatham. Clive picked up on sales and marketing tools that should be employed to boost your company's businesses opportunities.

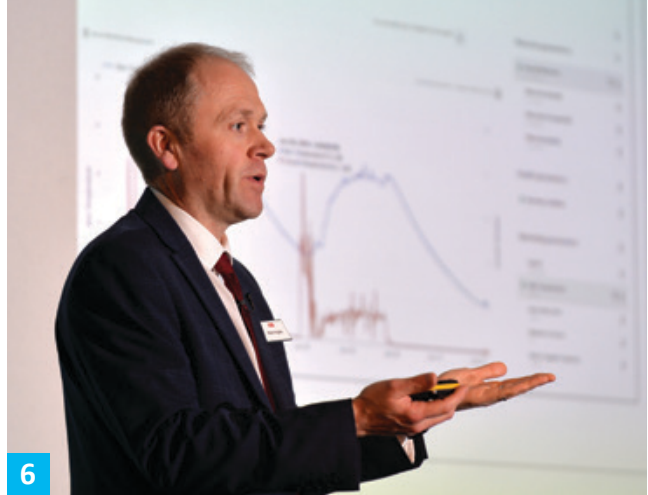
A welcome break at 4pm, when the conference closed, meant members had some time to relax, catch up with emails, or enjoy the hotel's leisure facilities, before the champagne reception began for the evening's Awards.

The evening's AEMT Awards careered back into the limelight for it's second year, and successfully built upon last year's triumphant inauguration. With more guests, drink, food, and awards than the prior year – the electrifying atmosphere of the gala dinner was also quick to gain momentum.

Cheers and whoops almost drowned out the enlivening beat of the audio-visual soundtrack as each finalist was read out. As winner by winner was announced, the excitement levels rose until reaching the evening's crescendo with this year's entertainment, straight from Air Force One – the American President, Donald Trump – or a very good impersonation of him in any case, by the extremely talented and hilariously entertaining Mike Osman.

A look across the proceeding pages will highlight those winners of this year's awards. Many congratulations to them for winning this year's accolades. ■

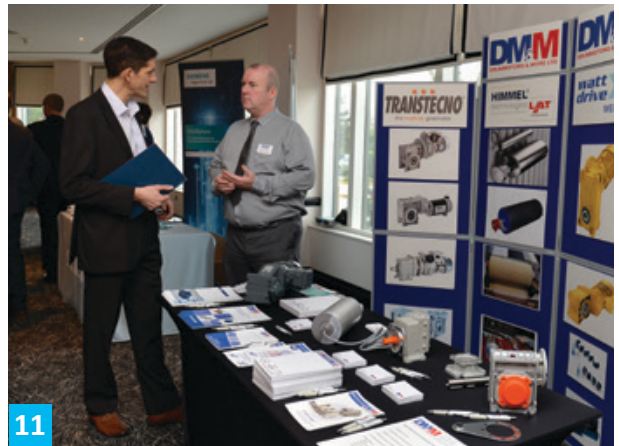




1. Thomas Marks, Secretary of the AEMT, opens the conference.
 2. Graham Warren and Mark Davies at the CEMB Hofmann stand.
 3. Joe Clarke of Rotor with Ronnie Moore of GES Group at the Rotor stand
 4. Gary Shearer of the Manufacturers Alliance meets Kevin Berry of Hayley 247
 5. Dr. Martin Killeen of AEMT at the Exalto stand with Dennis Rawle and Conference Delegate
 6. Steve Hughes of ABB presents 'Ability' to delegates.
 7. Dr. Martin Killeen of AEMT presenting the new repair standard.
 8. Tom Ison and Richard Emery of Sulzer and Roberto Movio of Nestech.
 9. Conference Breakout Session with Clive Reddihough of FMS



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- 10. Mike Cosgrove of Exalto speaking to Gary Downes of EMIR Software.
- 11. Julian Webb of Webb Elec with David Donoghue of Drummotors and More
- 12. Dr. Christian Mundo of SIEMENS presenting the Digital Twin.
- 13. Michael Herring of Megger Baker Instruments and Huseyn Aliyev of Rapid Solutions at the Megger stand.
- 14. Alex Page and Andrew Savage of MKE with Graham Brooker of Wilson Electrics



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- 15. Gary Downes, AEMT President, welcomes guests to the 2018 AEMT Awards.
- 16. Central Group win Project of the Year. Steve Ashman of EMIR Software, Shaun Sutton of Central Group, and Andrew Castle of TWM.
- 17. Westin Drives wins Service Centre of the Year with Rob Wood of ABB, Michael Limb of Westin Drives and Andrew Castle of TWM.
- 18. Mike Osman as Donald Trump entertains guests after the Awards
- 19. Winners and Finalists 2018 Group Photo



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Awards Sponsored by:



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20. Byworth Boilers 'Unity' wins Product of the Year 2018. Damian Oxley of Drive and Controls, Alexandra Holdcroft and Jason Atkinson of Byworth Boilers and Andrew Castle of TWM.
21. Ryan Meierhofer of MUSK Process Services wins the Rising Star Award with Tom Bouchier of FANUC and

Andrew Castle of TWM.
22. Andrew Savage of MKE wins the AEMT Lifetime Achievement Award with Thomas Marks of the AEMT and Andrew Castle of TWM.
23. The Faraday Centre wins Contribution to Skills and Training with Chris Powles of Sulzer, Ian Pattinson and Hannah

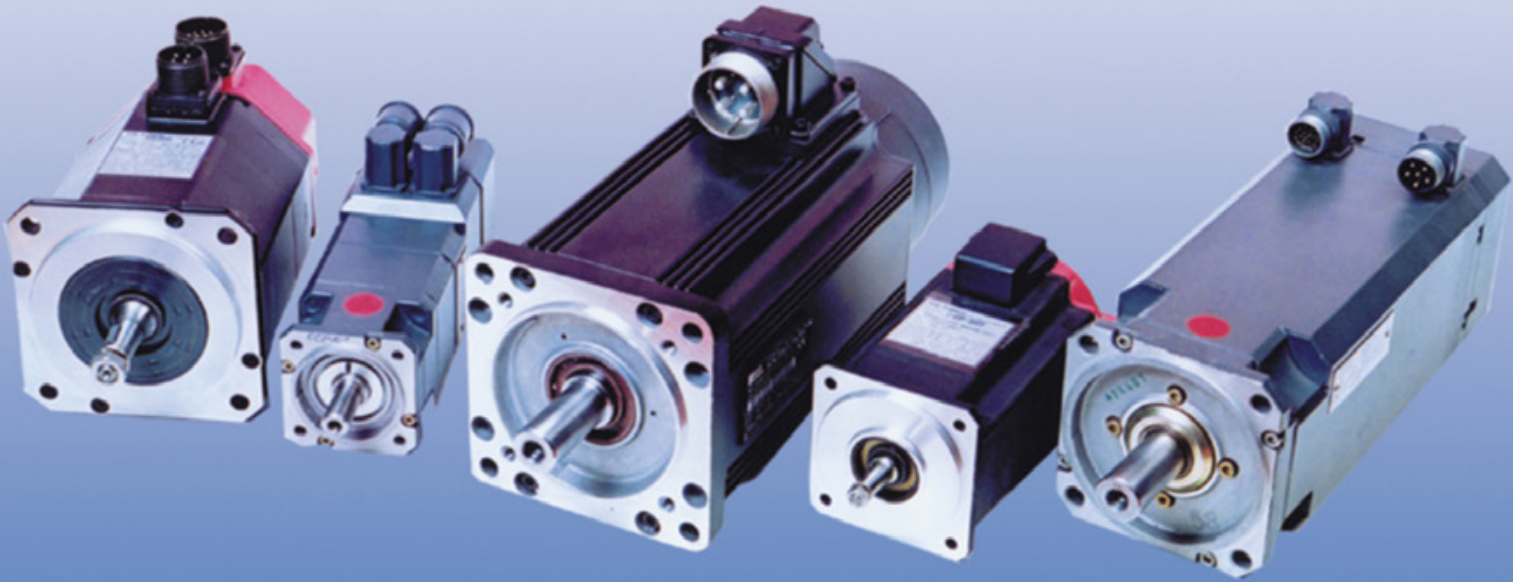
Thomas of the Faraday Centre and Andrew Castle of TWM.
24. WES wins Supplier of the Year with Shaun Carlton Greaves of MUSK Process Services, Mark Robinson of WES and Andrew Castle of TWM.

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