CONNECTED

MAGAZINE

SPRING 2023

BACKSTAGE AT THE LION KING

TEXTILE INDUSTRY CLEANED UP BY UK INNOVATOR

CONNECTING THE BIG BLUE: AN ENVIRONMENTAL STAKE

TOMORROW'S ENGINEERS RESHAPE THE CAR INDUSTRY

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19

IN THIS MAGAZINE

IMPRESSUM

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SOLUTIONS
OUR GREATEST SOURCE OF MOTIVATION

Are the products and services offered by my company among the best and most successful? Do they help customers to push back their limits? Or, even better, do they contribute to the well-being of society and the planet?

Far from being trivial, these questions make up the mission and purpose of a company. They impact its image and, even more importantly, the motivation of its people.

At LEMO, we are extremely lucky to be buoyed by our solutions. You appreciate them for their excellence – for us, creating them is already a good reason to get up in the morning. You are using them to bring people closer, cure and protect them, reduce human impact on the environment, drive scientific progress – which makes us proud of our work.

Concrete examples fill in every page of CONNECTED. You will discover venues producing performances that bring beauty and magic into our lives. Companies that develop innovative solutions to boost our knowledge about the oceans or to turn one of the world's most polluting industries cleaner. Young engineers anxious to make the world a better place. And the director of a major event bringing the cream of European tech together.

All these innovators are partners motivating us to progress and excel. In the somewhat grim current global situation, they are people who give cause for optimism.

We are thankful to them and thankful to you, merci!

Alexandre Pesci
CEO LEMO

TECH-BITS FROM AROUND

N°1

Artificial intelligence or genuine stupidity?

Since the launch of ChatGPT to the general public only a few months ago, artificial intelligence has made a splash, swinging between welcoming a new tool to serve humanity and demands for a moratorium to analyse the risks. Additionally, here come the more advanced representatives of "autonomous AI" (AutoGPT, BabyAGI...). What's the difference? If you ask them to organise a birthday party, they don't just draw up a list of tasks to be done but also initiate subtasks (choice of cake, presents, etc.). There are those who welcome the development of more competent help. However, the addition of "autonomous" to "artificial intelligence" does not reassure others. Especially as worrying uses have already emerged (ChaosGPT has been programmed to destroy Humanity). The greatest weakness of artificial intelligence is that it depends too much on human flaws.

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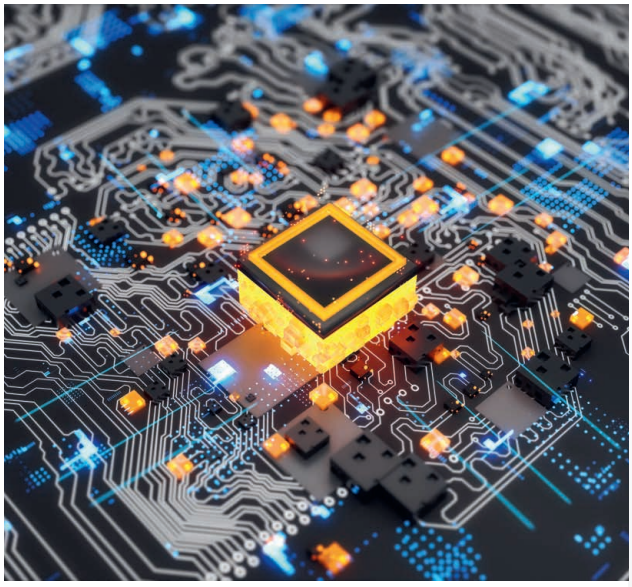
N°2

The art of approaching a giant

Whales may be the largest animals in the world, but they are not easy to locate and, more importantly, to track. The best way to collect data essential to their study and protection is to attach a tag to them. But how can this be done efficiently and without unnecessarily stressing these giants of the sea? Scientists have studied the feasibility of using drones, and their results (published in April in *Royal Society Open Science*) are promising. The study was conducted in the Gulf of California (Mexico) and lasted eight days. More than seven times out of ten, the drone succeeded in implanting the beacon (measuring speed, depth, acceleration, temperature, etc.) on the targeted whale. A rate of efficiency never before achieved, according to the researchers. The method is also particularly non-invasive: the boat remains 500 m away while the small, silent drone approaches, positions itself vertically over the whale, and releases its instrument.

THE WORLD



N°3

The Passing of a Silicon Valley Icon

Gordon Moore, innovator and visionary, died this spring at the age of 94. In 1965, he observed that, thanks to technological progress, the number of transistors on a microchip would be doubling every year - and he estimated that this exponential increase would continue. His prediction (corrected to "every two years") was to become known as "Moore's Law". It is not a scientific law but a self-fulfilling prophecy motivating chipmakers to take up the challenge. Gordon Moore also wrote - two decades before the start of the computer revolution - that integrated circuits would one day allow everyone to connect to a mainframe computer or to own a portable communication equipment. He became an actual part of this revolution when he co-created Intel in 1968. His company's rapid growth was a major factor in transforming a small place in California into what would become known as the Silicon Valley.

© Martin Stollberg, UniGE

N°4

A laser cannon to tame lightning

Since the invention of the lightning rod in 1752, there has been nothing more effective to protect against lightning. The problem is that a lightning rod protects an area the radius of which is approximately equal to its height. This is not ideal when it comes to protecting large infrastructures such as airports or wind farms. A consortium led by the University of Geneva and the École Polytechnique de Paris has come up with a new solution: an infrared laser pointed skywards as an extension of a conventional lightning conductor. The laser ionises the air it passes through, which becomes a conductive plasma and guides the lightning. The height of the lightning conductor is extended, so the area protected is also extended. In September 2021, the Laser Lightning Rod was tested for three months on the Swiss summit of Säntis (2502 m) on a lightning rod of the operator Swisscom, one of the most lightning-stricken structures in Europe. It took a year to review the results and confirm (earlier this year in *Nature Photonics*) the effectiveness of the solution.

THE FIRST PUSH-PULL SINGLE LINK 4K UHD

The LEMO Group will launch several new products this year. In particular, for UHD broadcast (winner of two "2023 NAB Product of the Year" awards) and communication in hostile environments. These are the first two insights.

4K resolution has been well established in the consumer broadcast world, driven by the evolution of professional applications. However, these applications do not use standard HDMI. In fact, movie cameras, medical imaging equipment and giant displays use transfer via SDI (serial digital interface) with much higher security UHD requirements (non-disconnection), reliability or cable length.

Such constraints also explain why professional applications often require several connections for transporting bulky data generated by 4K UHD images at the speed of 12 Gb/s. Not any longer: LEMO has just launched the first ever Push-Pull 12G SDI on the market.

The full name of this innovation – 12G-SDI 4K UltraHD – is a summary of its main characteristics. It is a quick coaxial Push-Pull connector that complies (by a solid margin, as proven by the tests) with the latest SMPTE ST 2082-1 standard. What the name doesn't say is that it is single-link (no need for multiple connections) and highly compact (12 mm diameter), which makes it space efficient. Nor does it say that it supports a signal frequency up to 12 GHz which allows for massive 12 Gb/s (nominal) data transfer. It is extremely durable and LEMO guarantees over 1000 mating cycles.

This new connector is also superior to existing bayonet solutions (BNC).

NEW HIGH FREQUENCY SOLUTION FOR EXTREME APPLICATIONS

Since late February, LEMO has expanded its M Series portfolio, a global benchmark for extreme environment connectors.

The new compact LM.232 has been specifically designed to meet the most demanding solutions for high frequency connections in the most adverse conditions. There are many potential applications: 5G or WiFi networks, embedded systems for military communications, radars, UAV and anti-drone technologies...

The solution comprises up to 12 coaxial (50 Ohm) contacts providing for a maximum high frequency transmission of 26.5 GHz. Developed entirely in-house, these contacts make it possible to reduce both the volume and the weight of connectors (30% lower than equivalent solutions). Quick and safe blind mating as well as colour-coding make it easy-to-use.

Just like other M Series connectors, the LM.232 is outstandingly sturdy. It withstands extreme operating temperatures (-50°C/ +200°C), shock, vibration, and humidity. It is also available in a watertight version (IP68 when mated) or with a threaded backshell (MIL-DTL-38999L).

A customer has already benefitted from the many advantages of the LM.232 for a critical application: a mobile VPN communication platform. Its small module/box is connected to several public network operators (4G or 5G) and generates an encrypted network ensuring reliable and safe communication between specific users.

In a similar way, the speed, reliability, ruggedness and ease-of-use of LM.232 connectors could be decisive for multiple applications in contemporary battlefields, where soldiers, drones, vehicles and various sensors collect and exchange increasing amounts of data in real time. ■

Push-Pull connectors are generally more robust and reliable than BNC (LEMO, the acknowledged leader of extreme environment solutions, is perfectly aware of that). It is also more compact, and its extraordinary ease-of-use requires less space. Two qualities that make the new LEMO 12G-SDI 4K UHD the ideal solution to equip cameras (where space-saving is a prerequisite) or to integrate several 4K UHD connectors on the same patch panel.

The obvious benefits of LEMO's 12G-SDI 4K UHD have very quickly convinced the market. National television stations and major camera manufacturers have expressed their interest even before the official launch mid-April. And, just ten days after its launch, it was awarded in two categories at the NAB show in Las Vegas.

It should be noted that the solution can also be adapted to already existing equipment, since LEMO proposes an adapter for coupling its Push-Pull 12G-SDI with BNC solutions. ■

LEMO 12G-SDI 4K UltraHD
Available in size 1 S (part number FGZ.1S.275.CTCE61Z)

EUROPE'S LARGEST TECH EVENT

© Viva Technology

▲
François Bitouzet, managing director of Viva Technology.

With its 50,000 m² exhibition area, 2,400 start-ups, 2,000 exhibitors, hundreds of conferences and over 90,000 visitors in 2022, Viva Technology has confirmed its status of the biggest event of its kind in Europe. Its general manager François Bitouzet spoke about the ambitions of this major tech rendezvous in Paris.

What was the purpose of launching Viva Technology in 2016?

We thought that the European tech, digital and start-up community was way too fragmented. On the one hand, there were start-ups creating innovation and disruption who were lacking resources and access to investors or potential customers. On the other hand, large groups – with resources and customers – seeking this type of innovation. Viva Technology's mission is precisely to unite all the players and foster meetings that could not happen elsewhere.

Hence the diversity of the sectors present...

Exactly. Unlike other exhibitions, we do not focus on a single sector or audience. We are a multi-expert event.

Who are these experts?

This year, we have 2400 start-ups; large groups like LVMH, Verizon, Manpower, Audi; pure players like Microsoft, IBM, Google, Meta, Alibaba, PayPal... and also – very importantly – the public sector: country, region and city representatives. So, it is a 360-degree event where these important meetings happen. Even the unexpected: a "deep tech" start-up and a luxury group may discover common interests – a green approach to winemaking? Everything is possible.

Is this a European event?

There's a strong European presence and we contribute to anchoring European tech on the global scene. Visitors from the US tell me that they travel all the way to Paris *precisely because* this is where they find the best of the European tech ecosystem. This said, Viva Tech

is not a European event: it is a global event held in Paris. Dozens of countries are represented – Korea is this year's guest of honour, for New Zealand it will be a first. All the speeches are held in English – only President Emmanuel Macron has the right to speak in French!

By the way, there are hundreds of speeches! Are discussions an important part of your programme?

Absolutely. We would like to think of the future of technology and what it will be used for. We would also like to ask questions, challenge models. The aim is to provide a snapshot of European and global technology and to make sure everyone leaves with an open vision. Viva Tech is a kind of crossover between a B2B CES and the World Economic Forum.

© Guilloux, Viva Technology

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With thousands of exhibitors and 90,000 visitors, the event is a breeding ground for innovative ideas.

Web 3.0, cybersecurity, "food tech"...: the topics addressed are extremely varied...

There is a very rich programme. However, we focus on a number of major topics, including artificial intelligence, at the heart of current debates and, just a year before the Paris Olympic Games, the future of sport. The main accent is on "Tech for good" – how technology can help meeting major social and environmental challenges. There is for instance a "FemTech" village which will address the topics of inclusion and diversity. Or else, an "Impact mile" – a 100 m long, 400 m² alley to promote tech or digital innovation that may very well lead to fundamental changes.

Can you give us a concrete example, among others?

I would mention Sweetch Energy. This French start-up has managed to develop a solution capable of harnessing osmotic energy, which forms where freshwater and saltwater meet. It is a rather tenuous form of energy, but Sweetch Energy's membranes, installed in river estuaries, are capable of converting it into 100% renewable energy, enough to power a big city!

These innovations are also presented to the general public...

Indeed: after three B2B days, Saturday is open to the general public. It is always highly inspiring, with loads of positive energy. Visitors come to discover new technologies (the latest "flying car", new energy sources, etc.), there's a sense of wonder and magic. But there is more to it than that: for us, this day is also an awareness day. We would like to demonstrate to young audiences that tech jobs are not exclusively for the elite, but open to all, including women, who are still largely under-represented. By the way, we will invite 3,000 female high school and university students. Exhibitors play along and it works: young people come to Viva Tech also to discover careers, companies and to share their CVs. ■

Viva Technology: Paris Expo Porte de Versailles, from 14 to 17 June 2023

FRENCH TECH AND SWISS-MADE

After exhibiting in 2018 and 2019, before the pandemic, LEMO will make a major comeback to Viva Technology this year. The Swiss group, a partner to "French Tech" for decades, fits perfectly in this world of excellence and innovation.

Just like major exhibitors at the Paris event, LEMO will promote several technological gems on its 40 m² stand. There will be Focal, famous designer of high-tech loudspeakers and headsets. Delair, leader of professional drone solutions for the industry and Defense. Finally, Namma, a young start-up proposing a real industrial "Swiss army knife": its Eva machine combines 3D printing, CNC machining and laser engraving.

This remarkable trio embodies the quality and diversity of French innovation and of LEMO solutions. Come and visit Halle 1, stand D41. ■

THE SHOW MUST GO ON !

Many traditional theatre, dance or musical venues have managed to stay as popular as more modern media channels, such as movie films, TV series and video games. However, times are changing with a growing number of the most prominent cultural institutions now seeking state-of-the-art equipment to enhance their offering and have better control over their broadcasting capabilities. Leader in UHD broadcast solutions, the LEMO Group is supporting this modernisation by helping prestigious venues enhance their production quality. Even performers are being kitted out with the latest technology to sensational effect.

With its lavish thirty-column façade and green domes, the Palais Garnier is one of Paris' architectural gems. Inaugurated almost 150 years ago, it is about to be further anchored in the third millenary by kilometres of fibre optics. Early this year, its younger brother, Opéra Bastille (1989) was also equipped with a brand-new network.

At the helm of these two prestigious sites, the Opéra National de Paris, a public institution under the wardship of the French Ministry of Culture. Its mission: to promote lyrical and choreographic art, namely by fostering the creation of contemporary artworks and training singers and dancers.

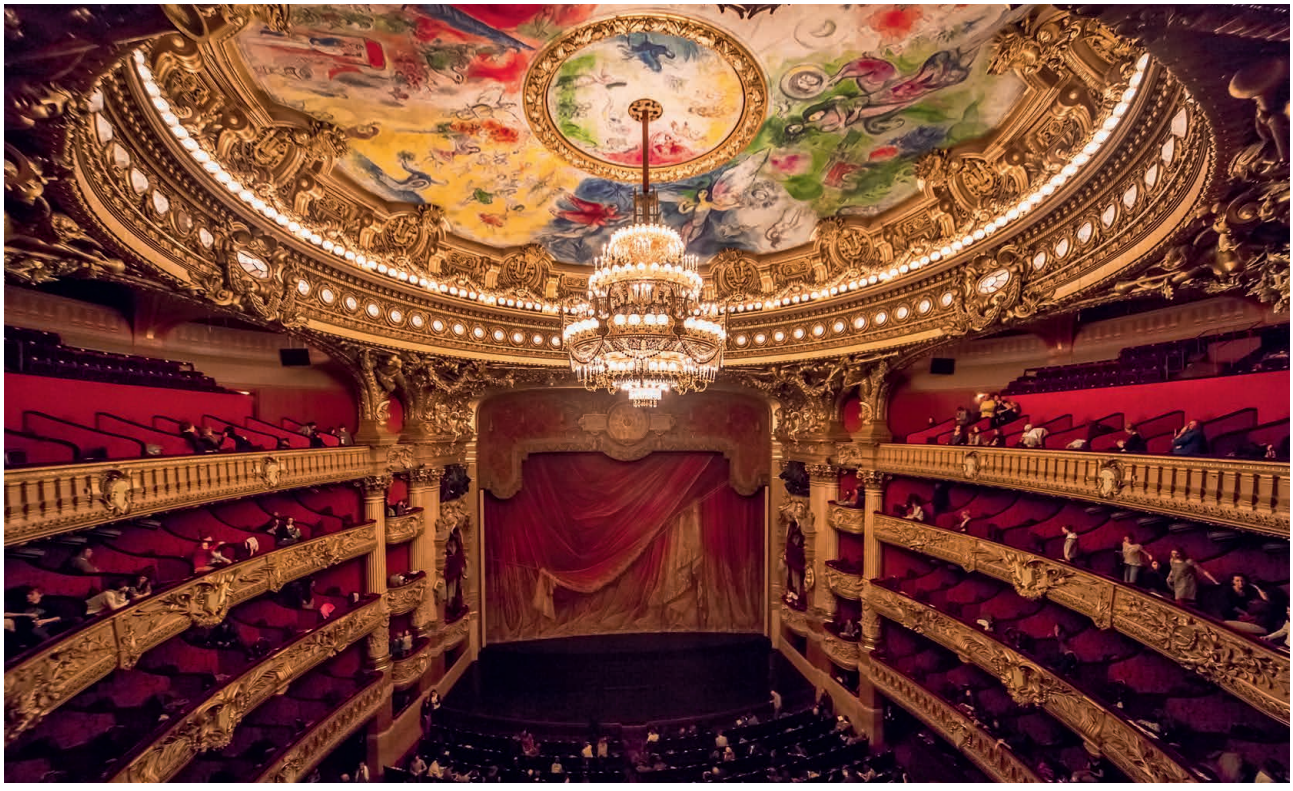
Sharing opera and ballet with the widest possible audience is part of the mission. For over thirty years, this is also ensured by television broadcasting, and both sites are equipped with a broadcast system (cable network, broadcast centres). This is how the various partners – headed by *France Télévision* and contractors of the European cultural television channel ARTE – connect their equipment. Unfortunately, broadcast companies have moved on to HDTV and the old triaxial copper system of both operas has not been compatible with their cameras for several years.

Then, in 2020, the pandemic arrived, and the shockwave sped up the evolution of the institution.

Overnight, the audience was banned from venues. How would it be possible to let them enjoy opera and ballet performances? *"Promptly, we came to an agreement with our partners to offer, on their platforms, a weekly broadcast"*, recalls Laurent Métivier, head of the audiovisual services of the Opéra National de Paris. Most importantly, in only a few months, a paid video-on-demand service was created. "Opéra chez soi" (home opera) offers recorded shows, but not only. In December 2020, *La Bayardère*, shot in an empty hall, was the first performance broadcast live on this platform. *"A great success, with more than 10,000 tickets sold!"* Other live broadcasts have followed.

So, the Opéra National de Paris, whose roots go back to the 17th century, has entered the age of streaming.

It wasn't the first to do so: the Royal Opera House in London, the Teatro Real in Madrid, the Teatro San Carlo in Naples and others have launched similar offerings. This is unsurprising, considering the many



Inside the Palais Garnier, the auditorium's famous ceiling painted by Marc Chagall in 1964.

© Edouard Grillot / Unsplash

Inaugurated in 1875, the Palais Garnier stands on the Place de l'Opéra, in Paris.

advantages, explains Laurent Métivier. "*We now depend less on our broadcasters. This is all the more important, as public channels tend to reduce their opera and ballet offering. Furthermore, the service makes it possible for us to connect directly with our audience.*"

Also, the audience has become wider than ever. Shows at the Palais Garnier and the Opéra Bastille are sold out (over 90% occupancy rate), but their audience is mostly made up of Parisians or residents of the Paris region. And foreign spectators (mainly Americans and Japanese) have been fewer since the pandemic. The online service audience is national and even international (70% and 30% respectively for "Opéra chez soi").

Confident, the Opéra de Paris has decided to further expand its offer. In late March, it replaced "Opéra chez soi" by "Paris Opera Play" (POP), a service with enhanced contents and interface. The "pay-per-view" is only maintained for live shows, various subscription plans are available, which means a more regular and welcome source of income.

To better equip the new service, the management decided to get rid of the obsolete broadcast systems. The time has come for high definition.

At the Opéra Bastille, the implementation took from November 2022 to April 2023. With 2745 seats in the main hall (and a second amphitheatre with 500 seats), it is one of the world's largest opera venues. Three kilometres of fibre optic cables (Northwire SMPTE 311) have been installed to replace the triax copper network. Connecting the eight new small "pan-tilt-zoom" Panasonic cameras (half of them are mobile) for video recording, the TV cameras (of the TV channels or the ones rented by the Opéra de Paris) for broadcasting, the AVID servers, broadcast centres, etc.

At the venerable Palais Garnier, a similar modernisation was launched in mid-April. The work is expected to be completed this summer.

The 2023-2024 season of the Opéra de Paris scheduled 19 operas (seven creations), 12 ballets (five creations) and a lyrical gala. If there was only television, the audience could watch only half a dozen shows. "*Thanks to the new broadcast system and POP*" says Laurent Métivier, "*we offer about twenty.*" Major effort is put into live broadcast, with ever-increasing demand and wider audience than for works from the catalogue. The institution also proposes other exclusive content, including master classes and documentaries.

Creating content in-house requires new know-how. There again, the Opéra de Paris adapts, working mainly with its staff (cameramen, technicians) hiring external producers and technicians if needed.

POP's offering "*perfectly complements*" that of on-site performances, extra-mural shows, cinema and television broadcasts.

What next? "*We would like to get directly integrated into major content broadcasters, such as Orange, Amazon, etc. With an app that could also be used in the interfaces of smart TVs.*

Making opera and ballet performances accessible to wider audiences is indeed the mission of the Opéra de Paris. Born centuries ago, bel canto and entrechats never stopped thrilling the enthusiasts. ■

For watching ballets and operas:
play.operadeparis.fr

BACKSTAGE AT THE LION KING

A record-breaking show that has been performed globally for over 25 years, this musical blockbuster is the result of the passionate work of a great number of artists and craftspeople. Our interview with one of them, in charge of the masks and puppets of the show's London production.

Disney's *The Lion King* hit the screens in 1994. With its story of sibling rivalry, powerful images, strong personalities as well as the soundtrack composed by Elton John, the animated motion picture has seduced both young and not so young.

It raked in almost a billion dollars worldwide and became the biggest blockbuster of the year. Disney thus entered its "second golden age".

Only two years later, the entertainment giant was already considering adapting *The Lion King* for Broadway. But how could the experience of the film be rendered on stage – the majestic beauty of the savannah, the dense jungle, the stampede of wildbeest, not to mention the cast of animal characters ?

Director Julie Taymor came up with a radical approach. Unlike the film, the musical would not stage animal characters, but humans who would represent them with masks and puppets. As for the setting, it would be reduced to a minimum, since even vegetation (grassland, exotic plants and vines) would be rendered by performers.

The scale of the production is colossal and the results have taken the audience's breath away ever since the 1997 premiere.

There are approximately a hundred staff working backstage ; on stage, fifty or so actors, dancers and singers with elaborate costumes and make-up who act, dance and sing, bringing to life 232 puppets of all sizes, from the 15-cm mouse used as a shadow puppet, to the 4-m elephant (manipulated by four people). From giraffes

On stage, fifty or so actors bring to life animal characters, namely the pride of lions.

(people on stilts) to flying birds (kites soaring above the audience on the end of fishing rods) and Pumbaa the warthog (an actor with a suspended costume measuring 2 m 44 and weighing 20 kg).

All in all, 25 animal species are summoned in an amazing opening sequence for "Circle of Life."

At the Lyceum Theatre in London, where the musical has been performed 8 times a week since 1999, the only interruption being during the pandemic, the guardian of this extraordinary menagerie of puppets is Joe Beagley. This easy-going bearded 39-year-old was still a Technical Arts and Special Effects student at Wimbledon College of Art when he started working for *The Lion King* back in 2005. *"I was then appointed Head of Masks and Puppets so, it's been… gosh!.. more than 10 years that I'm heading the department!"*

Four of his team of six (including himself) ensure the day-to-day running of the show, with the constant watchfulness of a gang of meerkats guarding its territory.

Every morning, they check everything to the finest detail. Whether the rubber tips on the crutches used by the performers are undamaged, whether the puppet mechanisms function smoothly, and the understudies are ready if required. Besides what is used in the show, there are multiples of each puppet/mask; Zazu (the royal major-domo hornbill bird) for example, has four exact replica puppets; one for the principal performer and three for each of the understudies. The importance of the character is reflected by the complexity of its puppet (articulated neck, beak, feet, wings, and eyelids). The understudy puppets act as a back-up and are ready to be swapped in, in case of damage mid-show. A wide variety of materials and techniques are used to fabricate these intricate masks and puppets and require a lot of maintenance. Everything must be ready before the start of the show.

▲

Our interviewee Joe Beagley, in charge of the masks and puppets of The Lion King show's London production.

"Safety is obviously our main concern, followed closely by the performers' comfort", says Joe Beagley. *"But aesthetics are also paramount."* Everything needs to be perfect to comply with *The Lion King*'s visual identity. The team closely monitors the lion masks, the originals having been crafted by Julie Taymor herself.

Two Masks and Puppets specialists touch up the paintwork regularly. Being used eight times a week, knocks and bumps are inevitable, and marks, holes and cracks are continuously repaired with carbon patches. *"It ultimately adds to the weight of the masks, so, every now and then, we do complete refurbishing as well. We do this while the performers are on holiday, so that upon their return, they find a spanking new and fresh mask or puppet!"*

When a new mask is required, a raw carbon version is moulded by a Canadian specialist company and shipped to the local production. It is then for them to do the painting and the final touches, whilst strictly respecting the original design, to the smallest colour detail. *"The only variations accepted are a slight adaptation to the local tint of light or the skin tone of the performer!"*

A male character in the film, the mandrill and shaman Rafiki is a female character in the show.

GREAT SHOW, MASSIVE BUSINESS

In "show business" there is always a "show". Disney's *The Lion King* is a full-fledged, all-in show: dozens of actors, dancers and singers, hundreds of costumes, Oscar-winning soundtrack composed by Elton John and Hans Zimmer, an inventive scenography... recognised by an impressive array of Tony Awards, Grammy Awards and dozens of other accolades worldwide.

In "show business" there is also "business". *The Lion King* is just as extraordinary in this regard. If we count the tours, the show has had 27 productions since its creation in 1997. It has been viewed by 112 million people in over 20 countries.

Currently, *The Lion King* is performed simultaneously on nine locations over three continents. Some 115,000 spectators go to see the musical every week, 17,000 of them at the Lyceum Theatre in London only.

Hollywood is pale in comparison. The first Avatar film, the biggest blockbuster of cinema history, grossed a little less than 3 billion dollars. *The Lion King* musical stage adaptation is approaching an overall global income of 10 billion.

Disney is well organised. Musical performances adapted from its animated movies *The Lion King, Frozen* or films *Mary Poppins, Princess Bride*... are overseen by Walt Disney Theatrical Productions. This entity was created in 1993 for the adaptation of *Beauty and the Beast*. It is part of the Disney Theatrical Group, which also includes shows such as *Disney on Ice* or shows hosted by Disney parks.

It is indeed a big machine, driven by thousands of artists and craftsmen like Joe Beagley. ■

A creative associate has been touring all of the performances of *The Lion King* around the globe to verify their consistency, which gives an idea of the almost extreme care to detail. From the fabric feathers carefully cut for the bird puppets to the hair fitted by the hand onto the lion masks. Hence, the original masks and puppets required 37,000 hours to complete. The same attention to detail is true for all the departments – some of the 350 costumes are decorated with thousands of beads, sewn on one by one.

Why such precision? Are these minute details really visible to spectators seated many meters from the scene? *"It is true that we could cut corners for a number of design components. For instance, by 3D printing some of them, rather than sculpting. However, the quality of materials and of our work is visible indeed, even from a distance!"*

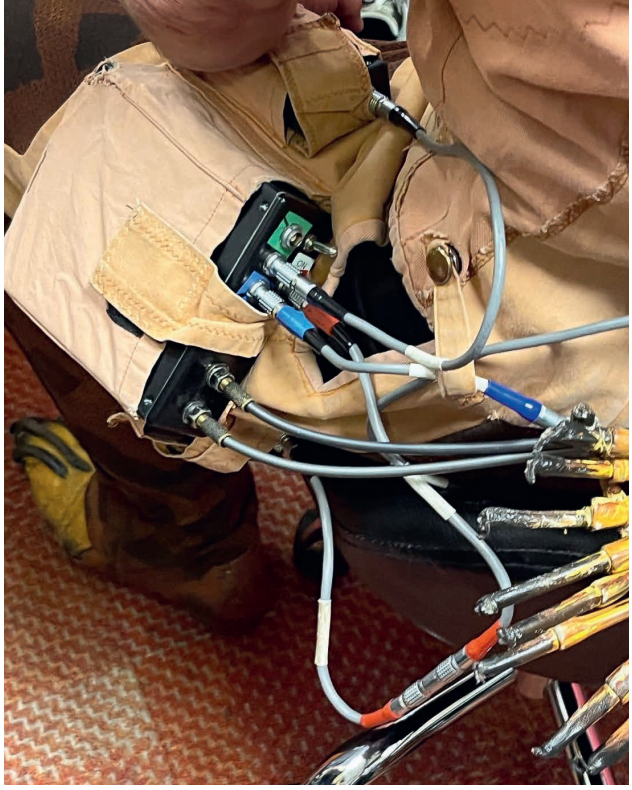
Perfectionism is a core issue in terms of credibility, insists the craftsman. *"Disney is always striving for the highest quality, and the audience expects it from us. Moreover, frankly, this quest also makes us quite proud of our work! We are part of a vast machine, but each and every one of us contributes to making the audience happy."*

Unsurprisingly, the puppets take up most of Beagley and his team's time. Most of the masks in the show are relatively simple and less fragile. However, two of them, the most important ones some might say, have built-in technology: those of the noble king Mufasa and his jealous brother Scar.

"Mufasa and Scar have complex personalities and a great duality", explains Joe Beagley. *"To better express such complexity, Julie Taymor and co-puppet designer Michael Curry chose to use mechanically articulated masks."*

The actors wear a discrete headgear made of thermoformed plastic, tailored to fit perfectly on their head. The articulated elbow support of the mask is fixed onto the headgear. Whenever the characters' emotions are composed, the lion masks stay above the actors' head, showing their facial expressions. *"But when they are overcome by their instincts, the masks are lowered and hide their faces – then their animality becomes dominant."* This subtle trick, emphasised by the actors' posture, results in a memorable dramatic effect.

The mechanism is controlled by the actors themselves. *"They carry a servo-box hidden in a pocket on their leg. From there, cables wind up on their back to the mask's articulation points. Electrical cables run up their back and along their arm to a small remote control, equipped with potentiometers and switches, nestled in the palm of their hand."* A subtle finger movement suffices to lift, lower or tilt the mask.



The connector solution that helps to articulate Mufasa and Scar's masks.

These hidden technologies are not subject to the same visual design restrictions as the look of the costumes. This has allowed Beagley's team to gain directly from modernising them without compromising on the look of the show: for example, the number of cables required for articulating Mufasa and Scar's masks have been drastically reduced. Originally, there were ten, now there are only about four.

Additionally, these cables are now no longer soldered onto the box, but rather connected by Push-Pull connectors (several LEMO B Series). *"This reduces the risks of failure and makes it possible to detect and mend the problem much faster!"* Which is a decisive advantage, especially when a breakdown occurs in the middle of the show...

© Disney

"With 250 puppets and eight shows a week, this is inevitable", explains Joe Beagley. *"You just know that there will be some damage."*

When breakdowns or malfunctions do happen, the actors just have to carry on until the end of their scene. Then, Beagley's team will attempt to repair if possible; replace with a spare if there is one; or, in the worst-case scenario, patch up temporarily to keep them going until the end of the show. Once the curtain comes down, a race against the clock begins to find a solution before the next performance (sometimes the very same evening).

© Disney

The most memorable incident experienced by the team involved the rather bulky elephant. The arrival of the giant puppet from behind the audience is one of the most unexpected and jaw-dropping moments of the show. However, on that day, as it was majestically walking down the aisle towards the stage, *"its skeleton kind of snapped in places!"*

Luckily, technical problems are usually more discreet, and the audience doesn't even realise when they happen.

© Disney

According to Joe Beagley, *The Lion King* was the first show of such scope to use so many puppets. By the way, it is still the only one to do so on such a big scale. There must be quite a lot of pressure throughout each performance. Beagley, who also supervises the tours of the show and contributes to the adaptation of Disney's *Frozen* simply shrugs. *"It is my life; I've had the time to get used to it! But it is true, that whatever may happen, the show must go on. No one, absolutely no one wants to be responsible for interrupting the show!"*

So, obviously, when the Masks and Puppets department is recruiting, "cool under pressure" is among the qualities required. ■

ANOTHER WAY TO DYE

UK textile industry innovator Alchemie Technology has set itself a mission: to revolutionise one of the world's most polluting industries, textile dyeing. Its solution holds great promises for environmental protection.

About a decade ago, during a business trip to China, British engineer Alan Hudd had a shock. At the end of a visit at a major textile dyeing factory, his customer took him behind the buildings to show a horrific scene: a blood-red river – wastewater from the dye baths leaching into the soil and entering the rivers. *"You must find a solution for this!"*

It is no coincidence that the customer turned to Hudd. He used to be a rocket scientist for the British Ministry of Defence. He had contributed to the invention of Shell mineral oil, which is still being used in our cars. He had created Xennia Technology as well, whose inkjet technologies revolutionised other highly polluting processes, such as the surface treatment for ceramic tiles. So, the engineer was well-placed to pick up the challenge without a moment's hesitation: he spent a decade developing an inkjet solution specifically for textiles and even created a new dedicated start-up.

Founded in 2013, Alchemie Technology plans to roll out its technology at scale this year, with a clear and ambitious message: Alchemie's digital dying technology will change the world.

Meanwhile, the environmental damage discovered by Hudd ten years ago has become even worse. Unsurprisingly: apart from some occasional optimisations (less chemicals, better waste recycling), processes haven't changed. Miles of fabrics are immersed in gigantic "washing machines" full of dye and water. Then excess dye is rinsed in a whole series of high-temperature baths. For finishing treatments (anti-perspirant, crease-protection, waterproofing, etc.) a new series of chemical baths and high energy treatment is used.

There is a massive waste, alerts Alchemie Technology: about 30 tons of water is used to dye a single ton of fabric.

The textile industry innovator mentions other horrendous figures during its presentations to investors and potential customers. The fashion industry is responsible for 10% of carbon emissions, textile dyeing alone for 3%. If nothing changes, the dyeing industry will continue producing 2.5 gigatons of carbon dioxide by 2050. Dyeing also generates 20% of industrial water pollution (the second main cause on a global level). Without changing anything, the industry itself will be in danger: increasing water shortage may jeopardise its activities and the energy cost explosions further erode its low profit margins. Indeed, many companies disappear – the dyeing industry is, well, dying.

Alchemie Technology's solution will make it possible to dye woven cotton with much less dye, water and energy consumption.

Considering the scope and the long-standing history of the issue, it is quite surprising that no fundamental solutions have been found so far. Alchemie Technology suggests several reasons. For too long, we have turned a blind eye on the massive pollution generated. It has only been for the last few years that pressure can no longer be ignored. There is also the usual resistance to change (resulting costs, giving up processes established for decades, etc.), in addition to uncertainties about the benefits.

Incremental improvements had no chance to trigger real change. An enormous leap forward was necessary, a radical solution. And this is precisely where Alchemie Technology enters with Endeavour and Novara.

Endeavor is similar to a digital printing machine used for producing publications such as CONNECTED. A fabric roll is fed in, whereupon a bar equipped with more than 1400 individually controlled nozzles jets drops of dye at high speed. This "printing" is rather intense, since the drops are much larger than those of a paper printer and there are 1.2 billion drops per linear meter. On the other side of the fabric, vacuum is created to ensure the dye penetrates the entire length of the fabric fibres, without creating any excess dye. Finetuning the process was what took longest for Alchemie.

Unsurprisingly, Alchemie could not possibly test every dye on every fabric. It started with woven cotton and polyester. For the latter, being hydrophobic, the dye is jetting on both sides of the fabric and fixed by infrared light. Using Alchemie's technology, cotton needs only to be jetted on one side of the fabric for complete penetration and even dyeing on both sides – this was a Eureka discovery for Alchemie.

Novara, the second machine, carries out the finishing treatments. The process is similar: chemicals are jetted on the surface of the fabric.

The quality of the final result is the equivalent of that obtained through classic processes, says Alchemie. As for the efficiency of the process, it has absolutely no equivalent.

As a matter of fact, Alchemie's liquid application technology circumvents the central issue of classic dyeing, the immersion into multiple baths. It is a non-contact method of jetting dye onto the surface of fabrics while achieving the same results as traditional methods. Alchemie Technology's machines have been specifically designed to reduce the water, dyes, chemicals and energy used to a strict minimum.

© Alchemie Technology

Endeavour, the machine that prints on the fabric, instead of immersing it into baths.

The results reported by the start-up are spectacular. These machines dye cotton using 95% less water and 70% less energy. They dye polyester using 95% less water and 85% less energy. The reduction in quantities of dye and finishing products is also drastic.

It doesn't take an expert to guess the environmental impact that such a solution could have on a large scale. With climate protection, we have become used to minute progress, at the best. Here we have a revolution.

The solution also benefits the industry. The spectre of water shortage and energy costs would no longer be daunting. Operating costs would decrease, increasing margins.

According to Alchemie, purchasing one or several Endeavours (they will cost about a million pounds – about 1,24 million dollars – each) would pay off very quickly. The machines would also contribute to improving working environment (modern printers rather than "giant Turkish baths") Much better for attracting new generations of employees.

Dyers are the main customers of Alchemie, but it has also been working on convincing the sector's decision-makers – major clothing brands. They could put pressure on their suppliers to embark in this revolution. Due to environmental awareness. Or because they want innovative products. Or for their brand image. Or all of this at the same time.

Alchemie Technology also has joint development projects with several major brands (names not available due to NDA) whose suppliers test the quality, performance and savings of this new way of dyeing textiles.

However, Alchemie is full of trust, given the massive interest in its solutions. The big fashion brands have set their 2030 objectives for sustainable development, in particular for water and energy consumption as well as carbon emissions. Endeavour and Novara have arrived just in time.

If everything goes well, meeting the demand would be Alchemie's only concern.

The company plans to deliver about 15 machines this year, about 50 in 2024, 500 in 2025 and to continue its exponential growth. The potential is not unlimited, but there it is: Alchemie estimates its market at about 30,000 machines.

In case of a huge success, its UK production capacity will not be sufficient. The start-up is planning to rely on external partners for manufacturing basic elements. R&D and core technology (namely the printing bars) should stay in the UK.

Alchemie Technology will also open demo centres in the major regions of textile dyeing. The first one in Taiwan (global capital of finishing treatments). Then in Portugal, Turkey, but mainly in Asia: Vietnam, Indonesia, India, Pakistan, Bangladesh...

Will digital dyeing technology change the world? You will soon find out at a fashion boutique close to you. ■

NETWORK FOR THE BIG BLUE

Rewarded at the last World Economic Forum, Italian startup WSense has been developing a platform that could become THE solution for underwater wireless communication. It could very well revolutionize studying and understanding our planet. Interview with its CEO Chiara Petrioli.

Science thrives on data. As such, the emergence of the Internet of Things (IoT) brought about a fantastic revolution. Billions of "intelligent objects" packed with sensors are connected to each other and to servers, capturing and exchanging, in real time, huge amounts of data. Analysed, accessible and shareable worldwide, these data enable researchers to observe and understand our planet like never before.

© WSense

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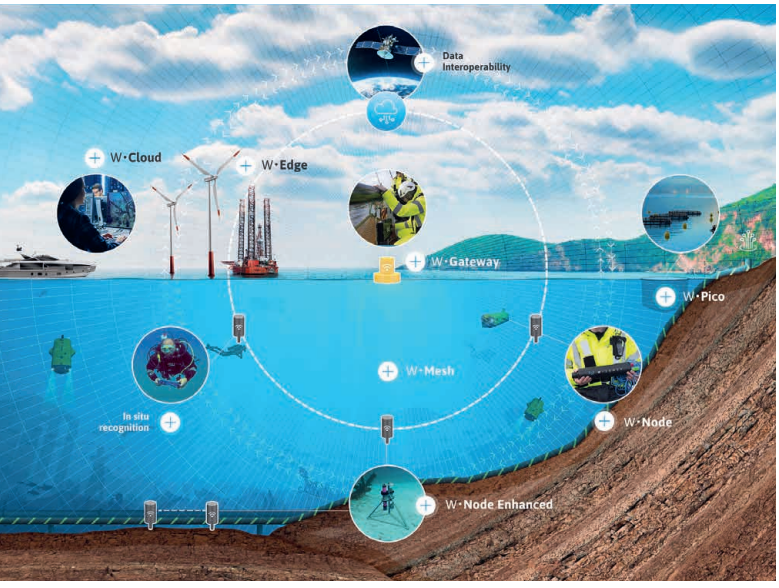
Two of the WSense nodes that build up the wireless network to which divers, cameras and robots will be able to connect.

Well, not *all* of our planet: IoT does not connect us to seas and oceans.

This blind spot is rather embarrassing. Water covers 72% of the Earth's surface, its volumes host 80% of biodiversity and play a pivotal role in global phenomena, such as climate change. It is impossible to claim a global vision without integrating the oceans.

There are a few marine research stations scattered around the globe (like needles in algal stacks). An increasing number of intelligent marine objects have also been created (sensors, buoys, autonomous vehicles, probes…). The foundations of an underwater wireless network are also being set up, which should be as accessible and reliable as the IoT, the "Internet of underwater things" (IoUT). A pioneer in the field, Italian company WSense has had favourable currents this year.

The network is also connected to the internet, so it is possible to send and receive data from anywhere.



© WSense

The adventure of the startup began at the University of Sapienza in Rome, where Professor Chiara Petrioli is in charge of a research laboratory. *"We started looking into underwater networks 10 years ago"*, she says. *"We wanted to find a way to transmit information reliably with elements like routers in large areas."* This research resulted in solutions *"achieving levels of reliability and performance previously not possible"* and several international patents were filed. Potential applications supported the creation of a spin-off: WSense was created in 2017 with a handful of PhDs and engineers (in the field of acoustics, network architecture, signal processing, etc.)

Today, the start-up employs a staff of fifty people with offices located in Italy, UK, and Norway. It has about twenty customers – "Blue economy" companies and scientific institutions. Its innovations have been honoured in 2022 by a Digital Challenge of the European Institute of Innovation and Technology and by a Blueinvest prize from the European Commission.

As you can imagine, "wireless network" and "underwater" are not made for each other. In fact, anything that makes aerial Wifi function does not work underwater. Radio waves are significantly attenuated, light or sound communication vary a lot depending on the temperature, salinity level, background noise… everything had to be reconsidered and that's exactly what WSense has done.

Their solution is based on an innovative combination of acoustic communication for medium-range distances and optical LED technologies for short distances, with a hint of artificial intelligence.

More specifically, underwater "nodes" are deployed. Data transfer between the nodes is permanently optimised by AI: whenever sea conditions change, algorithms modify the path followed by byte packets.

The system, explains Chiara Petrioli, can send data to 1000 m at the speed of 1 kbit/s and up to several Mbit/s over shorter distances. This bandwidth has of course nothing to do with aerial networks *"but we are working on enlarging it"*. However, it is sufficient for transmitting environmental data collected by the sensors.

The generated network is stable, reliable, and open: a plurality of devices (sensors, probes, vehicles) of various types and brands can be connected. WSense has designed its platform first for shallow water (up to 300 m depth), but now it asserts that it is operational up to -3000 m, opening the door wider to the oceans.

On the surface, floating gateways (or posted on nearby land) connect this local network to the "cloud", and so to the rest of the world – the IoUT joins IoT.

WSense designs all the software in-house (from network software to data processing) as well as all the necessary hardware: nodes, probes, modems, gateways…

By the way, its own devices are packed with sensors. *"They measure parameters such as temperature, salinity, pH, chlorophyll, methane, ammonium, phosphate, CO_2, waves and tide, background noise…"* In a nutshell: everything required for real-time follow-up and extensive surveillance of submarine environments.

Aquaculture was one of the first sectors to show an interest in WSense (still key customers). The deployment of a wireless network covering the rearing cages, without multiple bulky cabling, connects everything that provides for monitoring the biotope and controlling the fish farm. Cameras and sensors, as well as robots.

AN OUT-OF-THE-BOX DIVING EXPERIENCE

This summer, WSense will launch a miniature device: a "micronode" which could considerably enhance our submarine diving experience, just like smartphone applications have contributed to enriching our daily lives.

The size of a pack of cigarettes, the device is linked by cable (and LEMO W Series connectors) to a watertight tablet. Thanks to the solution, divers can communicate with the surface and among each other much better than by sign language.

"It also makes it possible for them to receive real-time information about what they see around themselves", explains Chiara Petroli. For the submerged Roman ruins of Baiae for instance, the tablet could show, in augmented reality, the reconstituted buildings visited by "diving tourists".

In addition, the "micronode" is equipped with a GPS, *"which increases safety, since the divers will always be precisely located. This option also opens new ways of exploring archaeological sites. It will be possible, for instance, to guide visitors along pre-defined itineraries. There are endless possibilities!"*

© WSense

▲

The new device adds interactivity, augmented reality, and much more for the divers.

This new product will be presented during the finish of the prestigious "Ocean Race" (a round-the-world sailing challenge) which will be held late June in Genoa (Italy). ■

"We are in the process of developing autonomous robotic systems", explains Doctor Petrioli. *"We can allow teams of robots to communicate and collaborate, to send data, get instructions and change their mission in real time."*

Following a request from a Norwegian customer, WSense R&D has recently developed an ultra-miniature fish wearable element. It makes it possible to closely observe the life and health of animals, whilst monitoring water quality. *"All this goes in the same direction: supplying tools to go further in the direction of a more sustainable fish farming."*

Similarly, WSense's platform can make it considerably easier to survey and work around off-shore stations, as well as underwater infrastructures, such as gas and oil pipelines.

It is just as efficient in more natural environments. The startup has deployed its network in sensitive sites and environmental hotspots. Scientists use it for instance for studying how algae, corals and animals adapt to climate change. In the field and continuously, *"which is much more precise than what we could do from the surface or satellites."* The solution also monitors sites that represent major risks for human populations, such as volcanic areas.

The WSense platform is also deployed in archeological or cultural sites, such as the submerged luxurious Roman city of Baiae, near Naples (Italy), which is part of the UNESCO World Heritage Sites. By measuring pollution and the effects of climate change or potential damage caused by visitors, it contributes to their protection the same way as it has for a long time in the case of on-land archeological sites.

Just like webcams placed around the world, *"those connected by WSense can also promote these sites."* They open windows for education and tourism, providing access to a larger audience than that of just scientists, companies or authorities.

The startup is also about to launch a "micronode" which, connected to a watertight tablet, would enhance the diving experience (see opposite page).

This new appealing product does not really embody WSense's true ambitions. The Italian company does not only offer, unlike others, "smart devices". It doesn't want to be just one more component in our already too fragmented knowledge of oceans.

On the contrary, it wants to unite *all* the components.

With this in mind, WSense has ensured the interoperability of its submarine network. For the same reason, it has also been working hard on making deployment simple and reducing costs, both prerequisites for its true purpose: to define the standard for IoUT.

For this purpose, WSense must enhance its notoriety as well as its platform. In January, it got a great boost from a place that hasn't seen any oceans for the last 200 million years: Davos, in the heart of the Swiss Alps.

During its last edition, the prestigious World Economic Forum (WEF) rewarded ten companies, including WSense, winner of its Ocean Data Challenge, an event for identifying the most promising technologies in data collection and management for ocean protection. The reward gives access to the WEF network, an ideal platform for finding people who could give support for global scale up.

There was an immediate effect: WSense spent the following weeks answering a flood of inquiries.

"It was huge", says Chiara Petrioli. *"We were able to talk to political and scientific leaders, top managers, who were often unaware of the possibilities. We could explain to them that the Internet of Underwater Things was not deep tech, but a solution ready to be implemented."*

Quick positioning on the submarine communications market is quite interesting (Forbes estimated it at 3.5 billion dollars, with a 22% increase per year). However, urgency lies elsewhere, insists Chiara Petrioli.

"We cannot delay applying these solutions. We must not go on ignoring so many things about the exploitation of the oceans or climate change. We must understand today, because it may be too late tomorrow." ■

▲ *Underwater wireless networks give continuous access to an unprecedented wealth of data about our oceans.*

GO FASTER, GO SMARTER

Across the globe, hundreds of young enthusiasts are busy adding the finishing touches to their impressive racing cars. They will compete this summer in the Formula Student, marking its 25th anniversary, and Formula SAE, the two most prestigious engineering student competitions in the world.

In a crowded office at the EPFL, the prestigious Swiss technical school, "Ariane" takes pride of place. Officially unveiled last May, this 3-m electric car, weighing 230 kilos, reminds of a crossover between a kart and a Formula One car. Students of the EPFL Racing Team are busying themselves around it, as they prepare for the first Formula Student competition of the year, taking place on 1st July in the Swiss Alps.

Meanwhile, in many locations around the globe, dozens of other teams (about twenty of them supported by LEMO, see page 28) are also getting ready. They too will compete this summer at Formula Student races (in Europe and Asia) and Formula SAE (in the USA), the two largest engineering student competitions in the world. It is rather frantic, since, every year, the rules evolve, which require the teams to create a new car design, and half of every team is renewed.

At the end of the day, vehicles look quite similar, but they are not equal at all. Savinien Semeria, president of the EPFL Racing Team, says laughing. "*Some teams have existed for decades; they take care of the smallest details for a few percentage points. Our team is young, we have much more than just details to work out!*"

In fact, the competitions require a large variety of competencies, all of them provided by the students. There is of course engineering (mechanic, electronic and materials engineering), project management, races (logistics, driving, maintenance) and even sponsoring and communications. So, every team is like a real enterprise – which is exactly the idea behind Formula Student (see "A race for innovation" next page).

Today, the EPFL Racing Team includes about a hundred students, the numbers doubled since its beginnings in 2019. Netflix series "Formula 1: Drive to Survive" buoyed applications, but it is not enough to be a motorsports fan. *"These projects require passion"* explains Rafael Riber, Team Leader Low-Voltage. Especially in schools like the EPFL, which do not integrate them into the already heavy curriculum. *"We meet in the evenings, on weekends... We spend countless hours on the project!"* Moreover, Formula Student competitions are scheduled during the holidays and the young students sometimes need to cover the travel and transport costs themselves. Some even pass their exams remotely during their participation at an event!

Since the students stay on board an average of 2 to 3 years, there is substantial personal involvement. Luckily for the Swiss team, progress has been just as substantial.

Their first car, "Orion" could not run in 2019 because of a safety issue. In 2021, after a year of pandemic "Mercury" performed quite well. Finally, last year, "Artemis" achieved the first podium places in individual events, including three first podium results (engineering design and autocross during the Swiss race, business plan in Spain).

In only four years, the EPFL Racing Team has moved from the 156th place to the 85th in the Formula Student general ranking.

Continued progress involves, as Savinien Semeria said, much more than finetuning details. The team has been ambitious: on the new chassis, there are many new features.

"Ariane" features, for the first time, a monocoque structure, more rigid than the tubular chassis used until now. It shifts from two to four-wheel drive, which has been the founders' dream, delayed for budgetary and feasibility reasons. Not without consequences: *"We were at the upper end of two-wheel drive cars"*, explains Semeria. *"Which is fine, but the cars that win the races are all four-wheel drive! It gives them 30% additional acceleration as well as a better control of the wheels – two decisive advantages."*

Therefore, "Ariane" is heavier than the previous cars. Its batteries shift from 430 V to the maximum authorised 600 V, the team will be able to better distribute and use the maximum allowed 80 kW.

Last but not least, the EPFL Racing Team has decided to line up in an additional category: autonomous vehicles. *"We have been considering it for years"*, says Riber. *"In fact, we have had a "Driverless" division and several students have dedicated their study assignments to the subject. At last, we can use this knowledge, which is highly motivating!"*

A RACE FOR INNOVATION

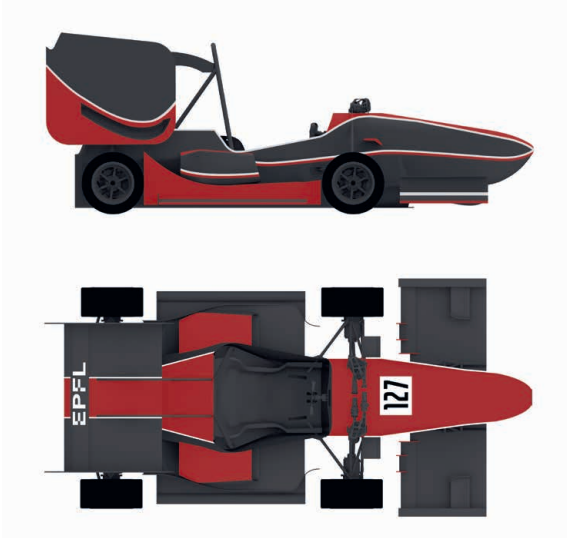
Formula SAE (Society of Automotive Engineers) was created in the USA in 1981. Formula Student, its European version with slightly different rules, in 1998, followed by Formula SAE-A, in Asia-Oceania, in 2000.

Their objective: to offer a practical experience to future automotive industry aces. De facto, all components of the development of a vehicle must be upheld by students (design to requirements, tests, finances, communication, etc.). Every year, hundreds of teams from the best technical schools around the globe participate.

These brilliant young minds also produce innovations that are likely to be applied in the automotive industry, which is the reason why so many automobile brands and suppliers support students and events.

The events often take place on prestigious circuits (Silverstone, Hockenheim). Four categories are proposed: Thermal, hybrid, electric and autonomous vehicles. Cars are subject to dynamic tests (skidpad, acceleration, autocross, endurance, efficiency) and static tests (business plan, engineering design & costs and production).

Every test result finishes on a podium, and, at the same time, it awards points for the general ranking of the event. ■



Ariane, 2023 car of the EPFL Racing Team (Switzerland) still at the development stage.

▲

A Formula Student competition (in Germany in 2022) brings together teams from dozens of technical schools.

While the "Driverless Software" division continues finetuning the algorithms that control the car, a "Driverless Hardware" division has also been created. It takes care of the sensors, the steering wheel and the breaks. Speaking of breaks: the safety rules of the "Driverless" category require integrating mechanical breaks which are independent from the system – another new feature the team had to work on. Each and every decision entails new challenges.

In parallel, the EPFL Racing Team has chosen a longer-term vision. *"We have designed some parts (batteries, chassis, aerodynamics...) specifically to serve for several years"*, explains Savinien Semeria. *"We have also recorded the tests and adopted knowledge transfer tools. All of this, so that our successors do not have to reinvent the wheel!"*.

All these developments contribute to an extraordinary lesson in engineering and entrepreneurship. They also drive up the budget.

Nine students are in charge of sponsoring (twice more than before) to gather the required 300,000 dollars. This mission, very different from engineering, is none the simpler. *"On the contrary, it is rather complicated, since the global situation has led to exploding prices"* says Semeria. *"We clearly understand that companies impacted, who have sometimes had to reduce staff, are reluctant to launch or maintain sponsorship."*

Nevertheless, dozens of large and small partners had to be found, the EPFL being the largest. The school granted the team a "Projects MAKE" status (concrete, interdisciplinary projects), which ensures financial support in addition to access to the workshops, facilities and dedicated production equipment.

Other partners contribute in kind, explains Rafael Riber. *"We have contacted a semi-conductor manufacturer for chips. Some companies lend us their production tools. Dassault Systems their 3D software to carry out life assessment, etc."* For its part, LEMO has supplied 170 connectors (including new M Series High Power, see CONNECTED 18), caps and accessories (power and signal) for "Ariane".

Working on all fronts, the EPFL Racing Team students have made significant progress. The design of the car was finished late September last year, production has started right after, peaking in January (among other things, the students do carbon injection

LEMO, A PARTNER FOR YOUNG ENGINEERS

The LEMO Group has been supporting tomorrow's engineers for a long time. Namely by financial and technological sponsoring of teams running in international student competitions (cars, motorcycles, clean boats, Hyperloop, robotics, drones).

The idea is to supply the best connectors on the market (often several dozens of them) to give young engineers a helping hand with their innovations (and increase their chance for victory). In return, the students give new ideas to LEMO's R&D, they become ambassadors of the brand (and sometimes they even become interns). The Group is particularly involved in Formula SAE and Formula Student, currently supporting about twenty projects.

themselves). Completion stretched from January to May. The car had to be ready by early June for testing on the EPFL parking, then on circuits provided by sponsors.

Finally, it will be time to compete with the rest of the world.

The Swiss team will run in three of the nine Formula Student competitions in 2023 (for reasons of cost and timing, most teams settle for 3 or 4 events). In Switzerland, in early July (electric category), in Germany mid-August (electric and driverless) and in Hungary (date to come) (driverless).

A whole student team will go on site, working on the car and sleeping in tents. Semeria and Riber are looking forward to it. They participated in some events last year and recall, starry eyed, the *"super atmosphere"* and the extraordinary solidarity of students who readily share info and give a hand.

In between the events, the students will not relax. Quite the contrary: frantic repair, corrections and enhancements will be necessary before the next race, until late at night, if necessary. This is how, last year, their business plan moved from the last to the first place, in a few weeks!

This summer, EPFL Racing are hoping for more than individual podiums. *"We are aiming for a podium in the general ranking"*, says Semeria. *"On the Hockenheim circuit"*. It is quite ambitious, as *"the German competition is the highest level of Formula Student and Formula SAE!"*

What if they don't manage? Never mind says Riber. *"We will have built solid foundations for our team, for the coming years."* This is what innovation is all about. ■

© DIAN Racing

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Like the Chinese of Dian Racing, the student teams redesign their cars every year to improve performance.

ON OUR JOURNEY TO A GREENER WORLD

When it comes to environmental protection, every step counts. The LEMO Group is proud to see its solutions being used in an increasing number of innovations that contribute to protecting our planet. It also pursues many initiatives to reduce its own environmental footprint.

Around the globe, LEMO solutions contribute to reducing human impact on the environment.

In the USA, delivery and garbage trucks release less harmful gas. Just like public transport in New Zealand and in Jordan. In Europe, China and North America, electric vessels, motorcycles and cars are carefully designed by engineering students dreaming of a greener world. In Germany, a company is preparing to launch electric flying taxis. In Switzerland, hyperloop pods are running at full speed in a tube, modelling the trains of the future.

LEMO solutions are used in equipment measuring sound pollution; they verify car exhaust pipe emissions and water quality.

1600 solar panels have been installed on the roofs of LEMO's headquarters.

They are also used for harnessing renewable energy. From classic – hydroelectric dams – to more innovative – aerial drones capturing wind energy and marine drones capturing wave energy.

A Finnish company keeps optimising its aquaculture. A French start-up's agricultural robots weed huge vegetable fields in an eco-friendlier way than chemical products.

The applications are not limited to those mentioned in CONNECTED (in this issue WSense, Alchemie Technology and Formula Student competitions). There are many, many more.

It is not a coincidence: to protect the environment, you must be out in the field and LEMO solutions are renowned worldwide for their reliability and robustness in the most extreme applications. Customers choose them for their reliability and resistance to the harshest environments. If our planet could choose LEMO, it would also do so for its durability. Since its early days, LEMO has designed solutions that are made to last long, even decades – as opposed to planned obsolescence.

The Swiss Group is proud of being part of innovative solutions respecting and protecting the environment. However, it does not only support its customers' commitment. Well aware of the impact of its industrial activities, LEMO strives to go beyond simply meeting compliance obligations.

Environmental protection has been progressively integrated into all aspects of its activities: management and production, whilst raising awareness among its staff. Moreover, the Group has also made medium and long-term commitments (2030) to contribute to global sustainable development goals. It will continue reducing the energy consumption of its sites and change progressively to green energy, despite the steady increase of its activities.

This global strategy is implemented through many concrete actions, which include: production plants (all certified ISO14001) apply a continuous improvement process; a chemist was hired specifically to optimise galvanic treatment; a proactive project was launched to use lead-free alloys; a customer-service dedicated to the environment and legal conformance (Reach, RoHS, CMRT, etc.) was created, processing over 1,000 requests per year.

In addition to its long-term global approach, LEMO encourages and supports a myriad of local target actions.

The most visible example is undoubtedly the installation of a solar power plant in 2022 at the Ecublens headquarters (Switzerland): the roof is now entirely covered by 1600 photovoltaic panels (3,000 m^2). In Ecublens, but also in the Delémont factory (Switzerland), thanks to new treatment installations, galvanic sludge is recovered and recycled (instead of being disposed of), avoiding the use of chemical products and drastically reducing water consumption.

Talking about water: drinking water stations have been installed at subsidiaries in Switzerland, the UK and the USA. At the Northwire factory alone, near Minneapolis, the filling station avoids using 44,000 disposable plastic bottles every year.

The changeover to LED lights at several subsidiary companies (in the UK and the USA) has enabled substantial electricity savings. In Germany, the adoption of LED lights and new production machines has generated an annual reduction of the energy consumption by 5,000 kW. The German subsidiary has also had green roofs for several years, optimising the insulation of the buildings in the summer and in the winter, in addition to offering green space to birds and insects.

Other green spaces have been arranged in the Netherlands: vegetable gardens. Initiated by a member of staff, the project encourages direct contact with nature, teambuilding and supplies local herbs and vegetables to be shared during lunchbreaks.

There are hundreds of further examples. Optimised heating, replacement of substances by less polluting alternatives, reinforced control, progressively eliminating anything disposable, improved packaging, etc. Whether ambitious or modest, all of these contribute to reducing the Group's impact in production and upstream.

On a global scale and considering the immensity of the challenge, these initiatives may seem to be modest. Are they insignificant? Not at all. Their effects add to those achieved by customer solutions. And to those put in place by all the companies, institutions or people who refuse to give up.

Safeguarding the planet is a long journey. And, just like for any journey, every step – big or small – counts. ■

NAB SHOW PRODUCT of the YEAR 2023 WINNER

THE FUTURE IN FOCUS

LEMO'S NEW 12G-SDI 4K ULTRAHD

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