



# TROVATI

# life

magazine no. 12

Arts and culture.

Artful air design.

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## Cultural transformation.

Digitisation has led to a radical cultural transformation that is not just taking place in our private lives: it is also affecting industry above all else. Everyone is talking about Industry 4.0 and the Internet of Things.

The industrial revolution 4.0 no longer just refers to the intelligent networking of components and systems; increasingly, everyday things are being equipped with intelligent sensors and minicomputers. Machine components report their next processing step of their own accord, postal packages indicate their delivery location, blood reserves from the Red Cross flag up the fact that they have expired or are no longer available, and TROX fans issue alerts about their maintenance requirements.

Of course, the transformation in corporate culture has also affected TROX, and although this has primarily come in the years after Heinz Trox, we are still following his guidelines – innovation, integrity and intensity – as he intended. In 2011, he launched the system concept with the development and production of air handling units. We are pursuing his line of thinking by intelligently networking components in a way that would allow them to react to changes in environmental parameters independently. Intelligent measurement and control technology developed in-house optimises the room air conditioning subsystem, reduces the numbers of interfaces and ensures energy-efficient operation. Safety and quality are top priorities in this case.

Even in arts and culture – the main subject of this issue of TROX Life – digitisation is making significant advancements. The digital piece "Rhein II" by Photoshop artist Andreas Gursky recently went for \$4,338,500 at auction. Gursky's pieces are undoubtedly works of art, but they are created with the aid of digital technology. For some art lovers, this is a source of real irritation. They see true art as a gifted craft which is free from any digital manipulation.

Two cultural flagship projects form the main focal points of this issue: the Elbphilharmonie concert hall in Hamburg and Lascaux VI, a reproduction of the famous caves containing prehistoric paintings in the Dordogne region of France. TROX technology has found its way into both of these palaces of culture in recent years. The next part of the issue then looks at two other interesting subjects that are in keeping with both project reports: acoustic design and painting techniques of the Stone Age. We also have several other articles to entertain you from the worlds of arts and culture.

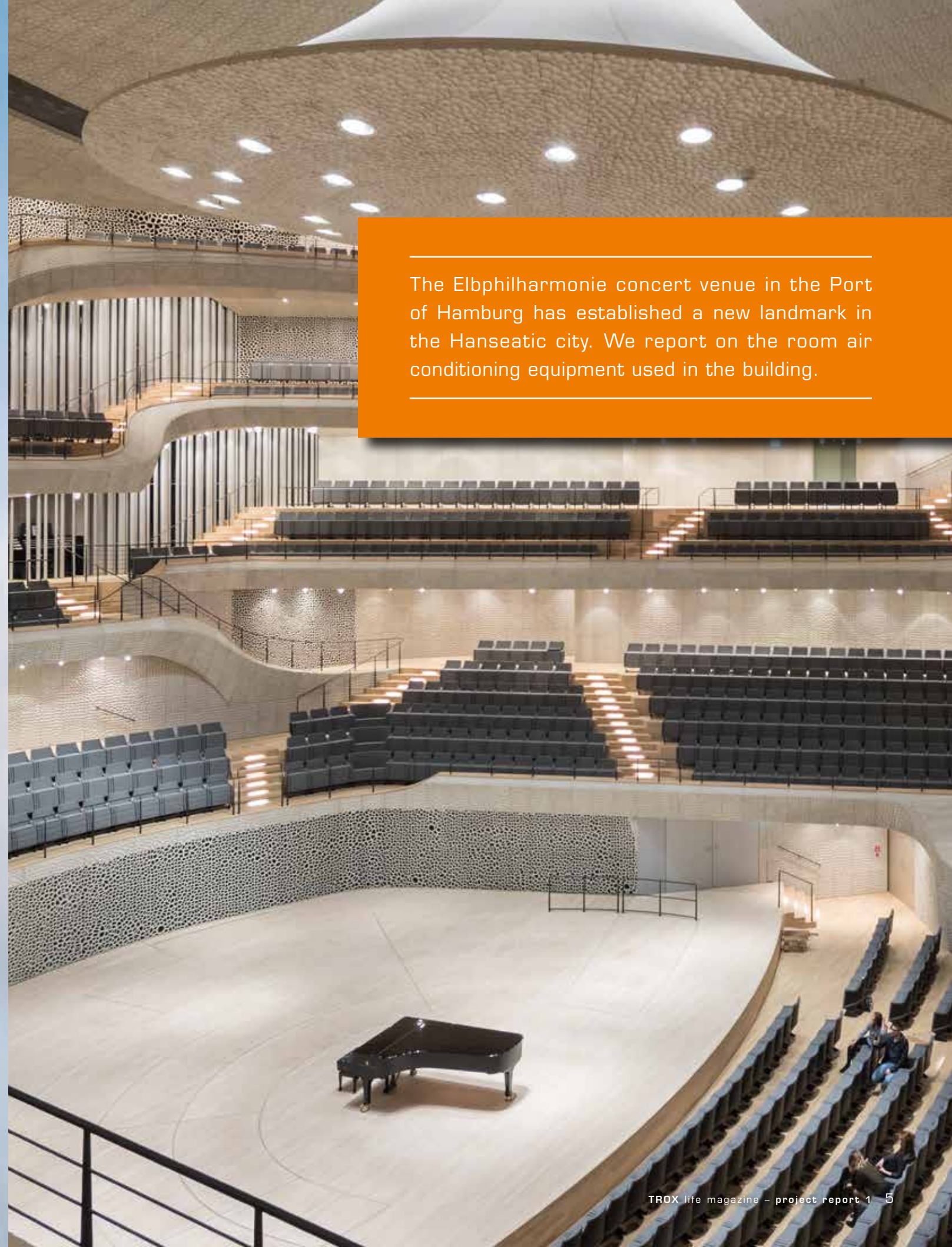
I hope you enjoy reading this issue.



Warm regards, Udo Jung  
 TROX Board of Management



# Elbphilharmonie.



The Elbphilharmonie concert venue in the Port of Hamburg has established a new landmark in the Hanseatic city. We report on the room air conditioning equipment used in the building.

The Elbphilharmonie concert venue opened its doors on 11 January 2017. When designing Hamburg's new landmark, architects Jacques Herzog and Pierre Meuron drew inspiration from three main sources: the ancient theatre in Delphi, sports stadium architecture, and tents. On the existing structure of the brick Kaispeicher building, a former warehouse, they have erected a glass form that features a curving roof and an unmistakable silhouette. The façade consists of more than a thousand double-glazed elements, many of which bend and swell in a variety of ways – lending the Elbphilharmonie the effect of a giant crystal. Each one of the panes, numbering approximately 2200 in total, is marked with its own individual pattern. The idea behind this, according to the architects, is to reflect the sky, water and city in ever-changing ways.

# Picturesque heights.





Foyer



Plaza



Recital Hall



Grand Hall



Special wall and ceiling panels with reliefs milled into them scatter the sound and distribute it evenly in all directions – creating the perfect acoustic experience.

**Musical delights.**

The Elbphilharmonie is home to two concert halls – one small and one large, seating 550 and 2100 respectively – plus a hotel, apartments and the Plaza, a large platform that is open to the public.

The large concert hall, known as the Grand Hall, was constructed on the basis of the vineyard principle. This design positions the stage in the middle, with terrace-style rows of seating surrounding it – a mammoth challenge for Yasuhisa Toyota, the acoustics specialist who was assigned to the project (see also page 12 onwards).

**Computer-aided acoustics design.**

Initially working on a computer, Toyota used complex 3D models to simulate the ambient sound in the Grand Hall. A plywood model of the hall was then constructed, incorporating 2000 little dolls dressed in felt garments. Tiny caps were used to simulate hair. Every element was precisely recreated on a 1:10 scale – including the wall structure, flooring and reflectors. As a result, the sound frequency in the test model had to be ten times higher than what would later be heard in the concert hall.

Sound recordings were also scaled down tenfold on a computer to provide an impression of how the sound in the hall would be perceived in real life. The majority of the echoes heard in the space were caused by the opposite wall.

**The white wall.**

Based on this work, 10,000 wall and ceiling panels were developed using highly compressed material made from gypsum and waste paper. Individual reliefs, created on a computer, were milled into the surfaces of the panels and indentations incorporated into them. The irregular faces that are the result of this disperse the sound in every direction and distribute it evenly throughout the room – so that one reflection is multiplied into several and the echo effect disappears as a result. Older concert halls used lavish mouldings and ornamentation to create this same function.

The innovative wall elements weigh between 35 and 200 kilograms, making them heavy enough to reverberate bass tones in the hall. Not only that, but they are also thick enough to absorb sound from the ventilation ducts behind them.

The rows of audience seating, meanwhile, are separated by wood panelling that conceals ten centimetres of concrete. This ensures that the frequencies of even the low-pitched instruments are reflected into the hall. The stage itself acts as an amplifier by absorbing vibrations, particularly from instruments such as cellos and double basses. The overall effect is one of a warm sound.



Yasuhisa Toyota

**Special acoustic measurements for the Elbphilharmonie.**

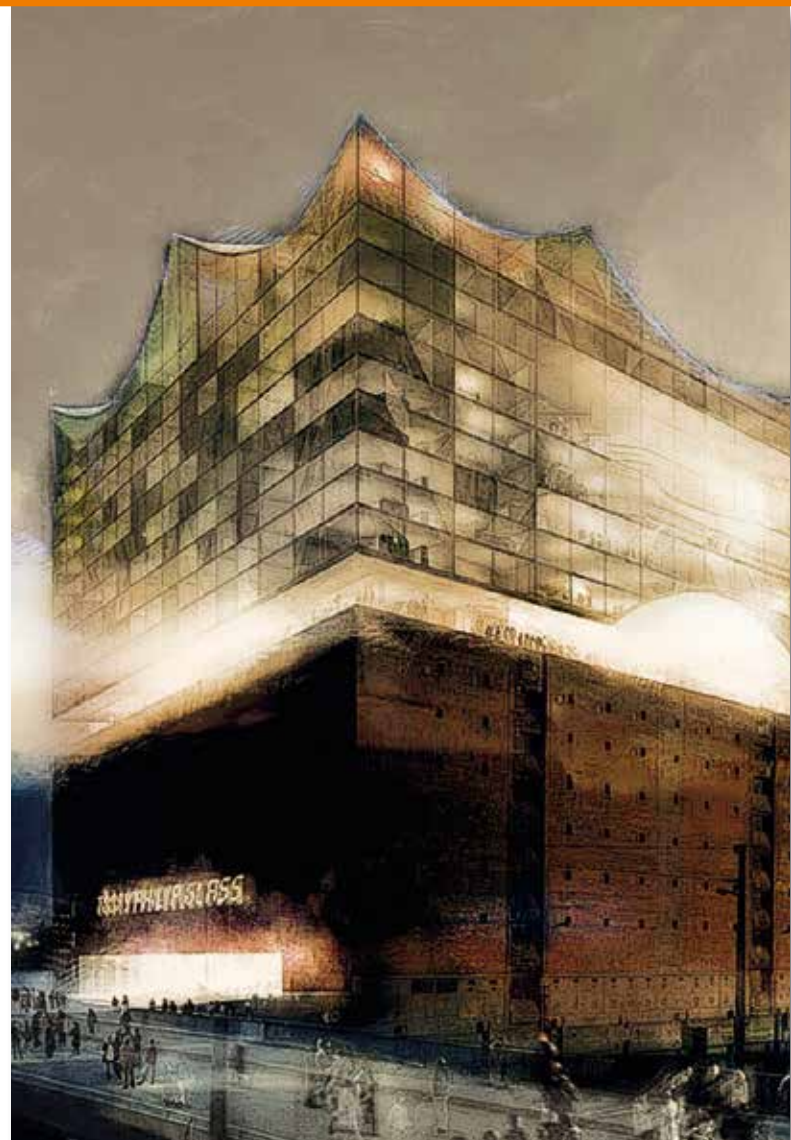
The horn of an incoming ship penetrates deeply into the Port of Hamburg. It is a sound to which locals are well accustomed – but for a cultural venue like the Elbphilharmonie, the sound power level produced by a horn blasting into the concert halls would be nothing but a disruption. With smoke extract ducts and smoke control dampers in the façade providing a potential route for the sound to find its way directly inside, this was a real risk. The specialist consultants responsible for the building services engineering set about finding a solution to this problem during the preliminary work on planning the room air conditioning concept for the Elbphilharmonie. It was this that led them to the acoustics experts at TROX.

To pinpoint the actual source of the problem, a smoke extract duct – including a smoke control damper – was installed, with its route leading to a measurement laboratory. The sound power level penetrating the sound chamber via the ducts was measured using a microphone in the chamber. In hindsight, the solution was simple. It was recommended that the building use two smoke control dampers installed end to end, rather than just one. This produced the necessary attenuation effect with no need to compromise on the safety functions of a smoke extract system.

**Comfortable room air conditioning.**

The room air conditioning equipment for the concert halls had to satisfy the very highest standards of air quality, air comfort and, above all else, acoustics. The aim was to prevent visitors from feeling or seeing the room air conditioning system – and under no circumstances were they supposed to hear it.

The four HVAC contractors entrusted with installing the Elbphilharmonie's equipment opted for, among others, TROX products in aspects such as fire protection and ventilation systems. In the area surrounding the concert halls, for example, fire protection and smoke control dampers ensure that a smoke-free environment is maintained in the event of an emergency. Swirl and displacement flow diffusers were also installed in order to provide a noise-free supply of air in Saal 3,



*Back in 2013, TROX set out an artistic vision of the bold architecture as part of a campaign.*



*DCS swirl diffuser with plenum box.*

the venue's third hall. TROX VARYCONTROL VAV terminal units of types TVR, TVJ and TVT-Easy are used for controlling the dampers.

TROX DCS swirl diffusers can be found in the Sky Lounge on the 20th floor, and are specifically designed to suit comfort zones of this kind.

The consistent quality monitoring and acoustic testing performed on TROX products – both new and existing – is another reason why TROX is chosen to equip spaces with acoustically sensitive requirements such as the Elbphilharmonie. TROX has two reverberation chambers at its disposal in its own acoustics laboratory. These meet the DIN EN ISO 3741 recommendations for reverberation chambers, and are used for conducting sound measurements that create the groundwork for developing new products or assist in this process.

For TROX, the opportunity to participate in the design of ultra-modern buildings is a source of both motivation and affirmation. Projects such as these motivate the company to keep spurring on the development of its products and systems, and they affirm that it is delivering services of the very highest quality.

As a result, when the Elbphilharmonie officially opened its doors on 11 January 2017, TROX had played its own small part in creating a venue that offered uninterrupted acoustic delights for concert-goers.



*Fire protection and smoke control dampers with excellent insulating properties.*

**Venue tours**

As well as a musical experience, the Elbphilharmonie offers tours that provide visitors with an insight into the unique architecture of this new concert venue.

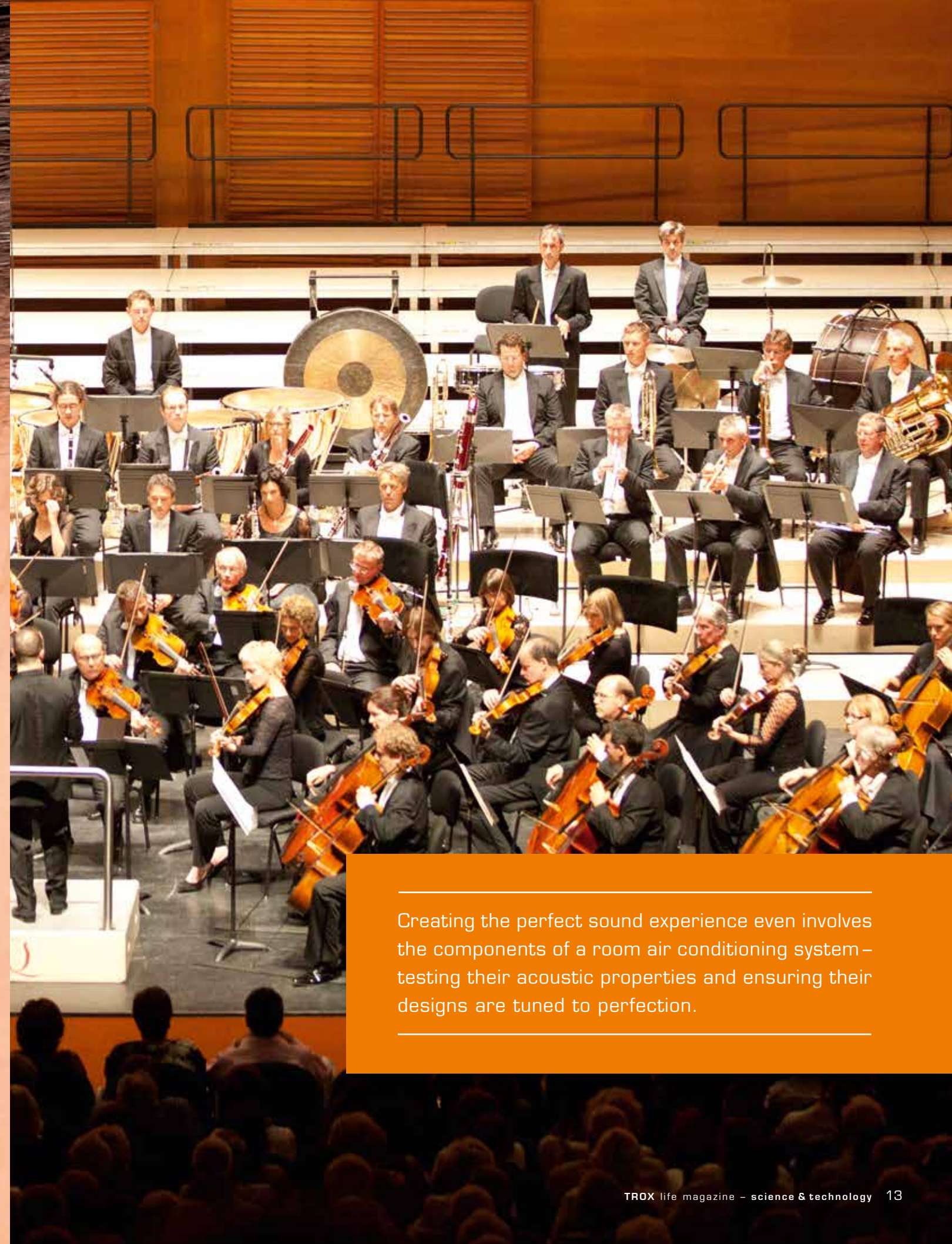
You can find information about the tours online at [www.elbphilharmonie.de](http://www.elbphilharmonie.de). The website also features a drone that takes you on a virtual flight through the impressive building.



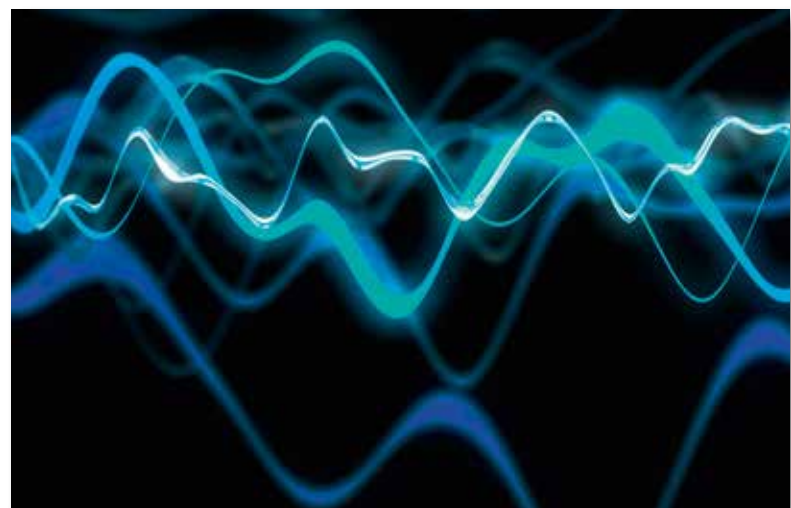
*Intelligent control systems ensure that the air supply into the concert hall is demand-based and, therefore, energy-efficient.*



# The mastery of sound.



Creating the perfect sound experience even involves the components of a room air conditioning system – testing their acoustic properties and ensuring their designs are tuned to perfection.



#### The art of acoustic perfection.

Planning the acoustics of a concert hall is a highly specialised, exceptionally difficult discipline. Concert halls are generally home to classical orchestras which may require as many as one hundred or more musicians to take the stage, or as few as two in the case of chamber music concerts, for instance. Both the conductor and the musicians must be able to register and evaluate the sound in a way that ensures each member of the audience – from the front row to the very back – is given an outstanding experience of the music and acoustics. Large concert halls can accommodate visitor numbers of 2000 and more. Clothing, hair, shoes, plus the various types of material used for the seats, walls and flooring are just some of the numerous obstacles that have to be navigated in creating acoustic effects. Sound can end up swallowed, blended, overlapping or reflected. Room acoustics represent just one piece of the jigsaw, however: creating the perfect acoustic experience requires several factors to work in harmony.

Describing his discipline of measuring subjective audio impressions, renowned acoustic technician Eckhard Kahle says: "There is a whole range of parameters involved in describing the characteristics of a hall, including reverberation, presence, spatial impression and timbre. The art lies in making these parameters, which can be measured as physical variables, work together in perfect harmony."

#### Shoebboxes and vineyards.

There are two schools of thought to which designers subscribe when it comes to concert halls: the vineyard style and the shoebox style. For some time now, architecture has encompassed more than just structural considerations. Creating the perfect sound inside a space is also a key focus of this discipline.

The classic concert halls of the 19th century were constructed according to the shoebox style, although there are also modern venues which use this design. It is based on an elongated, four-sided shape whose length is twice its width and height. The stage is positioned at one end, a conventional format. Although visually less attractive, the relevant sound parameters inside a shoebox design are easy to calculate. Kahle compares the process to a game of billiards, in which the angle of entrance has to be equal to the angle of exit.

The vineyard format, on the other hand, resembles an arena design. In this, rows of seating fan out from a central stage in the style of a vineyard, slightly overlapping one another. This kind of arrangement is significantly more complicated for acoustic designers to deal with. For this reason, the sound in the space is tested using computer simulations and 1:10-scale models.

#### Spreading the sound.

Going back to the textbook basics of sound, it is possible to describe a sound experience of the kind referred to earlier using the sober facts of physics. Sound is produced by vibrations (sound waves): fluctuations in pressure and density within an elastic medium, such as air or water, which transports energy and information. Sensors in the eardrum convert the pressure fluctuations into motion, which in turn is what creates auditory perception.

Sound emanates as waves in all directions. The number of pressure fluctuations per second is what is known as the frequency [Hz]. The wavelength determines the characteristics of the sound vibration and, therefore, the pitch.

#### See nothing, hear nothing, feel nothing: The ultimate aim of ventilation systems.

Within the field of room air conditioning, acoustics is a taxing discipline. As the fans in a room air conditioning system and air-regenerated noises both create sound that needs to be suppressed, they are considered to be sources of disruption that reduce comfort.

However, reducing the sound power level in an air conditioning system can often go hand in hand with a drop in energy efficiency, as sound attenuation measures inevitably lead to pressure losses and higher energy consumption as a result. In many cases, it is about striking the right balance – walking the tightrope between keeping airflow velocity to a minimum in the outlet cross-section of an air terminal device (in other words, the function) on the one hand, and the noise characteristics on the other.

#### Noise insulation, attenuation and prevention.

Insulation prevents sound from spreading into neighbouring elements and rooms by means of sound reflection. Keeping components decoupled stops sound from being transferred by acoustic bridges. Because of this, elements such as fans are installed in air handling units using spring clips.

Attenuation uses absorption to stop sound from spreading; this may involve sound energy being converted into heat in the mineral wool of a splitter sound attenuator, for instance.

Noise characteristics are primarily dependent on the airflow velocity in the outlet cross-section and around the outlet area. Room air conditioning systems house all kinds of noise sources (such as fans, air ducts, damper units and diffusers). Optimising air distribution in a way that prevents air-regenerated noises is a basic way of cutting down on sound. To put it simply, the more smoothly the air is conveyed, the less air-regenerated noise there will be – particularly at high airflow velocities.



**Sound measurements at TROX.**

Aerodynamic, acoustic and fire resistance testing is performed on every product type in our laboratory. Based on the reverberation chamber process, a microphone is used to measure the sound pressure in frequency ranges of 50 to 10,000 Hz, making it possible to calculate the sound power level in comparison with a reference noise source.

**Measurements during product development.**

During the development of a new product type, the Research and Development department is there every step of the way, ensuring that the flow behaviour, sound generation, pressure loss and production aspects are all tuned to perfection.

**Reliable data.**

Once all the aerodynamic and acoustic measurements are complete – as well as the fire protection tests in the case of fire protection and smoke extraction components – they are entered in the catalogues and design programmes required for selecting and sizing our products. In product types that have already been introduced, any changes to the design that have a bearing on flow or acoustics, for example, will require measurements to be performed again. These measurements ensure that both our specialist consultants and customers alike benefit from reliable technical data and know that planning will be performed with absolute certainty as a result.

**Acoustic measurements in a pilot series.**

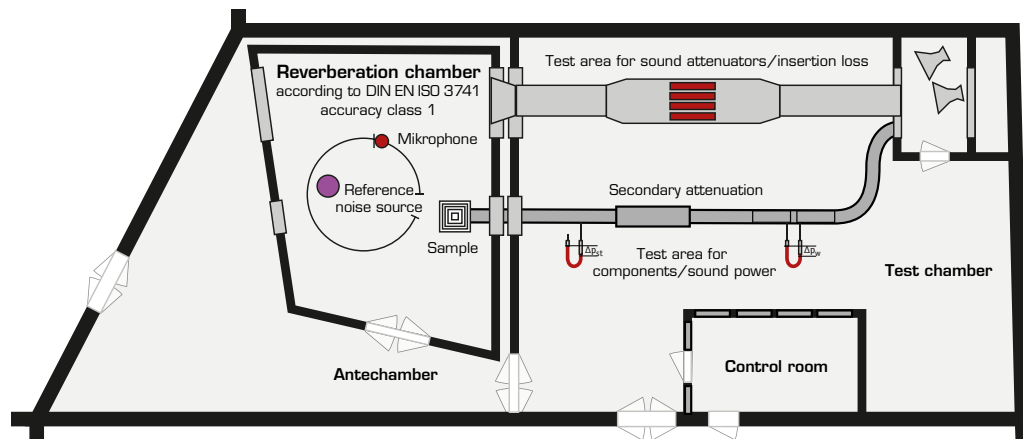
A pilot series is what is produced after the development period for a new product type. Each one of the product variants has to undergo an extensive range of tests in Research and Development, relating to flow, pressure loss, acoustics and other aspects. Around 5000 individual measurements were performed in the reverberation chamber for the new PURELINE slot diffuser. The reason behind such a high number of measurements is that each aspect of the products has to be measured in the reverberation chamber with all other parameters kept constant:

- Different lengths
- Number of slots (1, 2, 3 or 4)
- Slot widths (18 mm, 35 mm or 50 mm)
- Operating modes (supply air and exhaust air types)
- Various emission directions

Despite each individual measurement taking just 16 seconds, the process as a whole lasts several weeks.



*In the TROX laboratory, components' acoustics properties are tested and optimised, including the air control blades for the new slot diffuser – a small detail that has a big impact.*



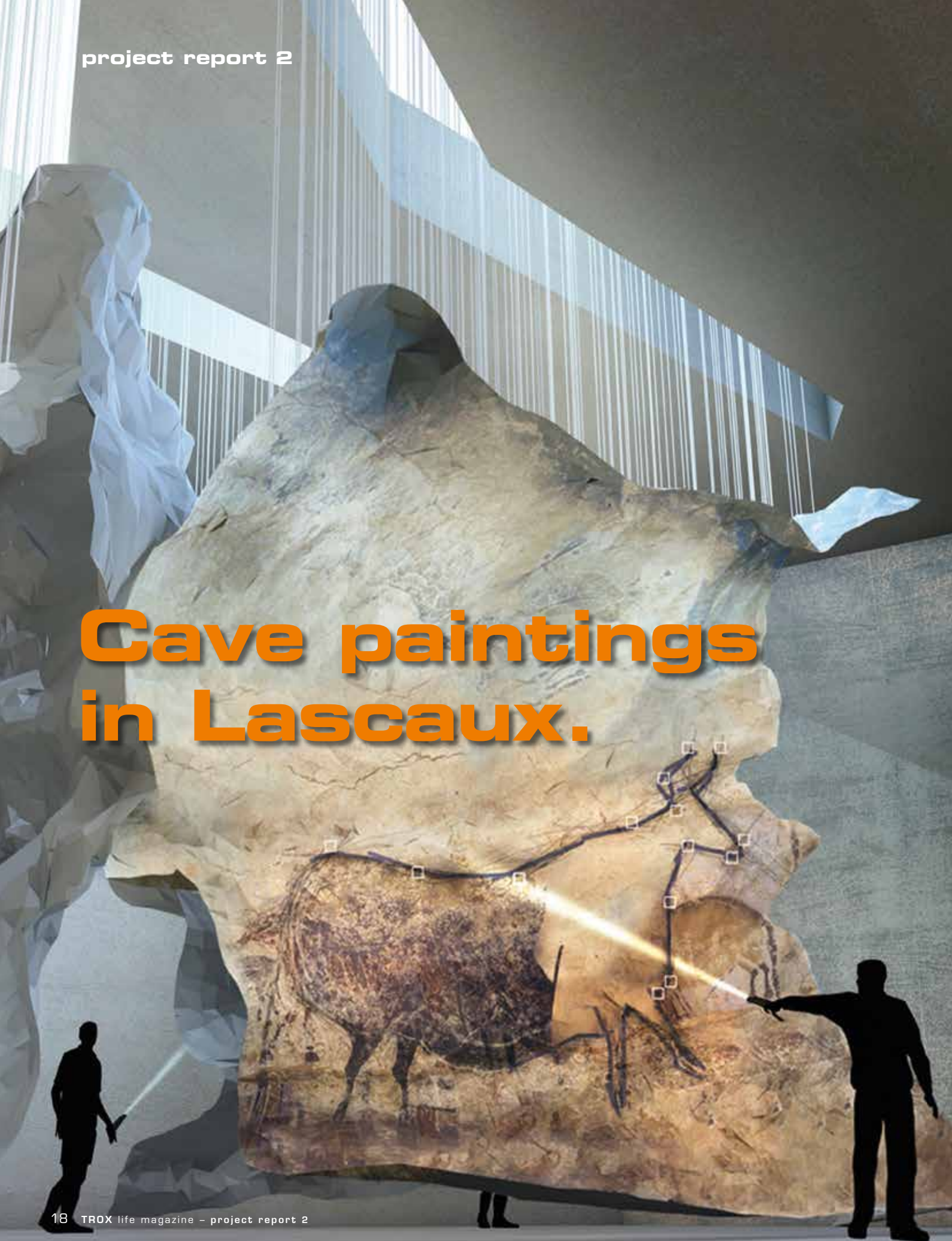
**Flow optimisation.**

In the new PURELINE slot diffuser, plastic air control blades ensure that the airflow changes to a horizontal direction when it exits the air terminal device. These blades are responsible for something known as the Coanda effect, in which the supply air attaches itself horizontally to the ceiling of the room. Thanks to today's innovative additive manufacturing methods, we are now able to generate prototypes of a plastic part, such as air control blades, in a 3D printer and then adjust certain criteria quickly and directly in order to achieve the ideal flow outcome. This is how it has been possible to create air control blades for deflection that feature not only the right aerodynamic characteristics, but also excellent acoustic properties while maintaining a low level of pressure loss.

Additionally, an online tool\* for acoustic calculations in accordance with VDI 2081 enable our customers to calculate the noise and attenuation values of components within a room air conditioning system and then select the right TROX sound attenuators from our range.

\*[http://qr.trox.de/acoustic\\_en](http://qr.trox.de/acoustic_en)

# Cave paintings in Lascaux.



The cave of Lascaux represents one of the most significant sites from the Stone Age. Now, it is possible to marvel at the paintings found inside it in a reproduction of where they were created.

In the Dordogne's Vézère valley in southwestern France you can find the world-famous cave of Lascaux. It was discovered accidentally by four young people in 1940 when their dog fell into a cavern: on descending into it after their pet, they found that it was actually the entrance to a cave. When they discovered the cave, they were suddenly confronted with giant, colourful pictures of animals on the ceiling – which would later turn out to be paintings from the Stone Age.

The cave paintings were initially thought to be early Magdalenian, an era falling approximately between 17,000 and 15,000 B.C. However, other artifacts that were subsequently found cast doubt on this and it was suggested that the cave could be even older, with some experts placing it in the Périgordian period (around 36,000 to 19,000 B.C.).

**A flood of visitors threatens the microclimate.**

After Lascaux opened to the public in 1948, it attracted around 1500 visitors per day. It was not long before the first problems began to rear their heads. Organisms brought in on the soles of visitors' shoes and carbon dioxide on their breath proved



The upper Paleolithic cave of Lascaux, in the French Département Dordogne, contains some of the oldest paintings known to man. The paintings are estimated to be around 17,000 years old. (Picture: Conseil Départemental de la Dordogne / Snohetta)

hazardous to the images created by the Stone Age artists. The cave's microclimate became imbalanced, and fungi, mould and algae began to grow. As a result, the site had to be shut down in 1963. By that point, it had drawn approximately one million visitors.

**Lascaux IV – Recreating the Sistine Chapel of the Stone Age.**

The French town still wanted to give visitors the chance to marvel at these significant prehistoric masterpieces, however, and so it constructed a cave of around 250 m in length in the form of a museum – around 200 m from the entrance to the original cave.



The Lascaux IV museum shows replicas of all the works of art in the cave. The museum, which is officially called Centre International d'Art Pariétal – Lascaux IV, opened in late 2016. (Picture: Conseil Départemental de la Dordogne / Snohetta)

The paintings were reproduced with faithfulness to the original versions, applying virtually the same techniques and colour pigments that would have been used millennia ago. On 12 December 2016, French President François Hollande officially opened Lascaux.

**Room air conditioning creates a cave climate.**

At the heart of the museum are ten exhibition rooms that replicate the cave. Their aim is to allow visitors to experience not only realistic reproductions of the Stone Age works of art, but also the damp and cool climate that prevailed in the original cave.

TROX France supplied the air conditioning and ventilation components and units required to create this atmosphere. For the customer, TROX's ability to deliver everything from a single source was extremely useful, as this reduced the need to coordinate all the aspects involved in the work. The central elements of the project are 21 X-CUBE air handling units that have been specifically configured to generate an air temperature of 16 °C and a humidity level of 90%, with the required cave climate in mind. They condition – in other words, filter, cool and, as necessary, humidify or dehumidify – as much as 130,000 m³ of supply air each hour. In this damp and cool climate, the special features of TROX air handling units are really able to come into their own. Not only do the special stainless steel condensate drip trays, with sloping on each side, plus the vertical arrangement of the modules ensure that the condensate is removed in a controlled manner, but the special powder coating (conforming to corrosion class IV) also protects the unit against corrosion. As well as this, the highly flexible and modular structure made it easy to install the units in the complex cave environment, while type XSA and



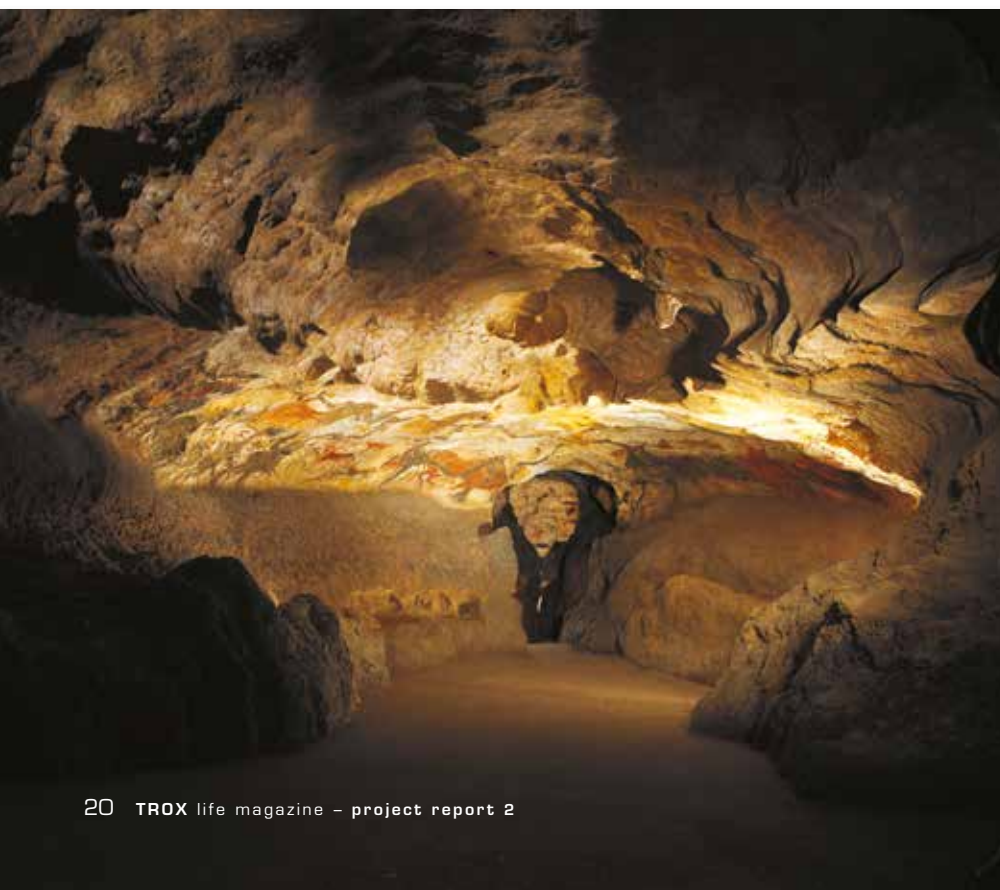
21 X-CUBE air handling units provide the museum with 130,000 m³ of conditioned air per hour. (Picture: TROX)

MSA splitter sound attenuators ensure that the air conditioning system cannot be heard.

The cave-like architecture requires the use of all kinds of air conditioning and ventilation components and systems in order to maintain a constant and pleasant climate. TVR and VFL air terminal units ensure a constant airflow. DUK jet nozzles, meanwhile, enable the air to be distributed widely in broad areas. Additionally, the site uses XARTO ceiling swirl diffusers. These diffusers have fixed air control blades and allow for an omni directional horizontal air discharge. The VDL swirl diffusers featuring actuators have adjustable blades which make it possible to achieve exactly the required volume flow rate and airflow direction during heating and cooling. VSD slot diffusers and QL-WE-O displacement flow diffusers have also been installed in the museum.

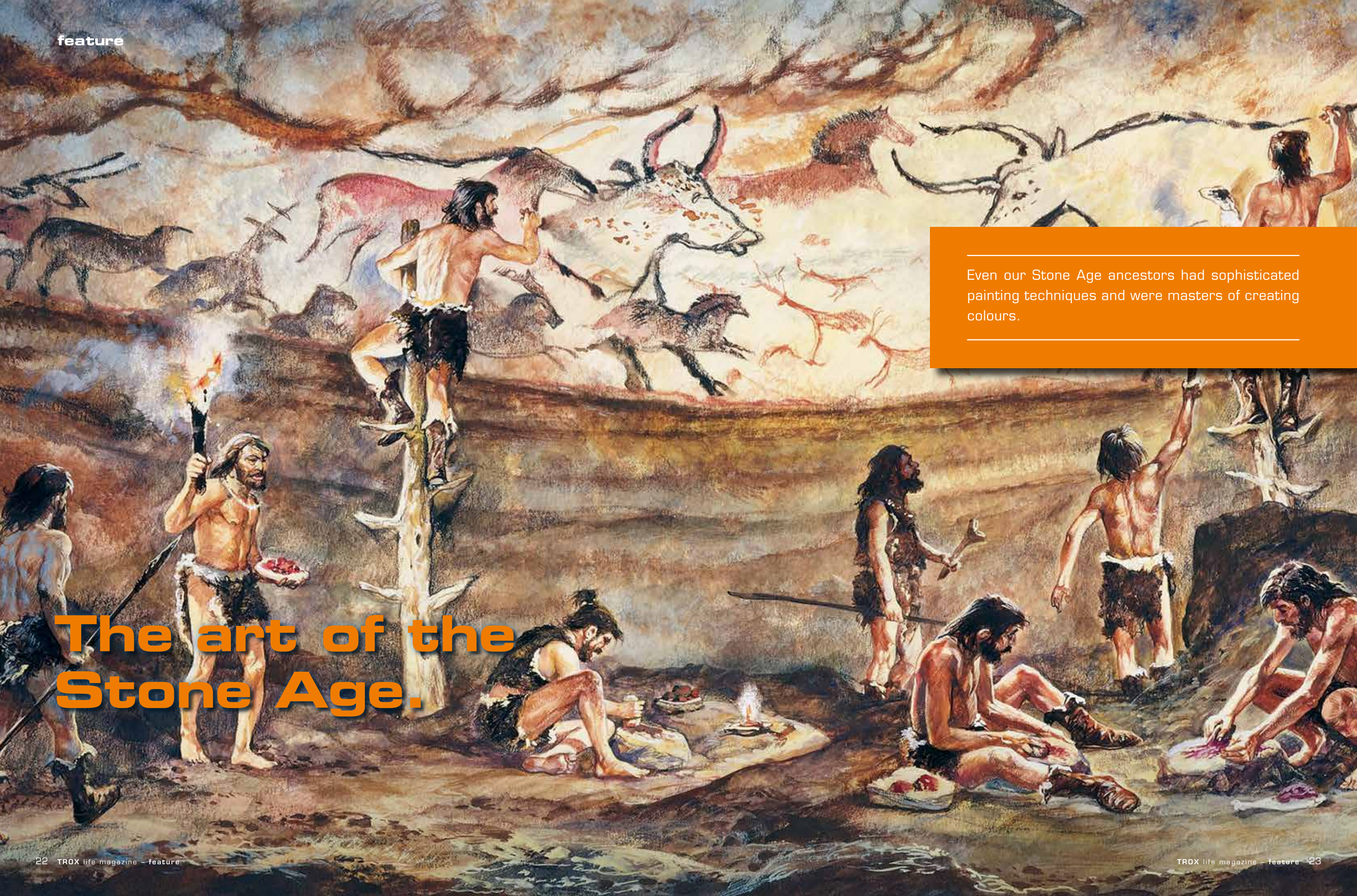
The Lascaux project has been a very special challenge for TROX France, and not only because of the complex technical requirements. The opportunity to participate in a project of such cultural and historic dimensions has also been a great source of motivation for the TROX team in Rungis, near Paris.

Building owner: Conseil Départemental de la Dordogne  
 Architect: Snohetta  
 Main contractor: SOPRECO (a consortium with the companies LAGARRIGUE BTP, SIORAT and SUD FONDATIONS from the NGE Group)  
 Main planner: Alto Ingénierie  
 HVAC contractor: Eiffage Énergie, Salleron, ATSE Bordes  
 Construction cost: EUR 34 million



Type VDW diffusers with actuators make it possible to achieve exactly the right volume flow rate and airflow direction.

A look inside the cave of Lascaux.



Even our Stone Age ancestors had sophisticated painting techniques and were masters of creating colours.

# The art of the Stone Age.

It is astonishing to see the unique works of art created by Stone Age artists with the limited resources available to them some 30,000 years ago and beyond. The wall paintings bear witness to such extraordinary abilities that the first discoveries were thought to be contemporary fakes.

The people behind the works of art remain a mystery. They were likely highly regarded tribal members who held a special status, such as shamans. It is suspected that the paintings related to cultures and rituals. Were they perhaps a way of conjuring good luck during hunting – since the themes are usually hunted animals such as aurochs, mammoths, lions or bears? Carved figurines of women were also found in the caves, and presumably had roles in fertility rituals.

**The use of colour.**

The Stone Age artists used dyes with properties that have enabled the works of art to remain preserved up to the present day. They were, however, limited in their choice of colour: the paintings mainly consist of red in every shade as well as black and grey tones, with yellow, brown or white occasionally coming into play. Red was made from iron ore pigments such as haematite and magnetite or ochre, a mixture of various weathering products from iron ore. Charcoal and manganese oxide were used to produce black colours. The cave painters at that time were already familiar with the technique of heating ferrous stones, which produced a lasting bright red. Finely distributed biotite or fool's gold was also found in some caves, creating an attractive glimmer on the surface.

They also cleaned the colours, washing out any unwanted substances that were also inside them. Adding clay, talc, feldspar or granite helped the Stone Age artists to ensure better colour coverage.



Haematite with magnetite

Charcoal

Biotite



**Stone Age painting techniques.**

Colours were applied directly with hands or bunches of moss. The cave painters simply mixed the colours directly with the soil on the clayey ground. Oils, fats and resins were likely used to mix colours in cases where the ground was rough and damp. It is plausible that the mineral-rich water from the caves, blood or even the painters' own saliva was mixed in as well. The artists also practiced wiping techniques in order to create pastel shades.

The Stone Age artists had processing and painting techniques which are still being used in similar ways today. For example, they scratched images onto rock using flint, either as lines or in the form of whole reliefs.

Dots and lines were drawn with fingertips or brushes made of chewed-up twigs or animal hair. In order to achieve a three-dimensional effect, many artists skilfully incorporated cracks and rock projections into their art.

Surfaces were filled using a prehistoric spray technique, whereby the pigment was ground into a fine powder which was then sprayed flat onto the rock face using the mouth or a hollow bone – an early form of airbrushing. They could place their hand on the stone as a stencil technique to create a negative image of it.

Fat-filled containers with animal intestines as wicks served as lamps in the pitch-black caves. Many of these recessed stone containers were found in the caves.





# TROX Middle East prepares for Expo 2020.

The world exhibition Expo 2020 in Dubai provides the ideal platform for TROX to raise the general public's awareness of the importance of indoor air quality.





Submissions to the design competition

international

In 2020, Dubai will organise the next world exhibition for the 180 nations coming together and the 25 million visitors officially expected between October 2020 and April 2021. TROX Middle East is seizing the opportunity to address the topic of indoor air quality at this globally recognised major event. Inspired by the Expo logo, our designers have developed a special air diffuser for the occasion: the Xsmart Air, which draws on the pattern and colours of the logo. It is the driving force behind the Xsmart Air Initiative, whose aim is to make the significance of good indoor air quality an entrenched value in the public eye within the Middle East region.

TROX has received the green light to create a close partnership with the Air Quality Department, a division of the UAE Ministry of Climate Change and Environment. TROX Middle East was also honoured with no fewer than three accolades at the Climate Control Awards:

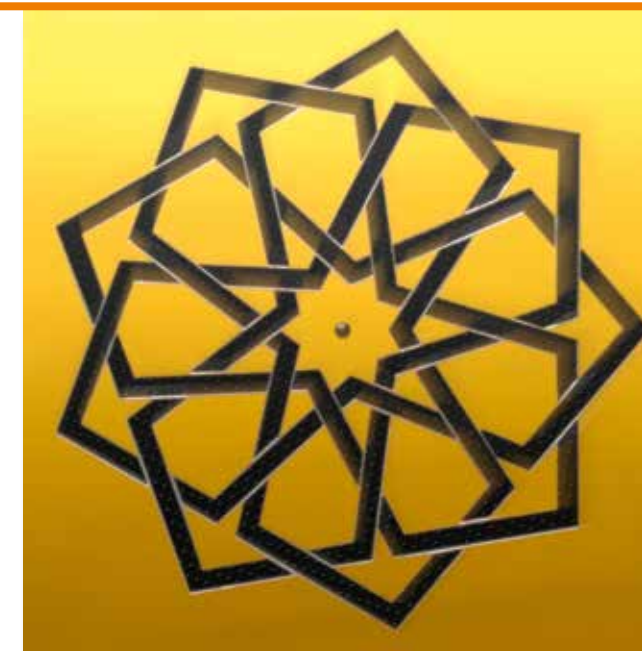
- Best manufacturer of ventilation and air-conditioning technology with X-FANS fans
- Best air treatment product with the X-CUBE
- Marketing initiative of the year with Xsmart Air

**"Air is Life".**

As part of the Xsmart Air campaign, TROX Middle East worked with the American University in Dubai during September 2016 to create a design competition for students of architecture and interior design: the "Air is Life" competition. The goal was to raise public awareness of the importance of good indoor air quality for our health and to broach the subject of how bad air impacts our lives negatively every day.

The thirteen finalists familiarised themselves in depth with TROX technology components and used them to create pieces of art. According to Prof. Albert Fakhoury, Chairman of the Department of Interior Design, the students demonstrated outstanding creativity, innovation and inquisitiveness when interacting with the TROX technology.

The winners were announced as part of the Future Cities Award on 8 December 2016. A jury composed



Xsmart Air diffuser



of international experts in the fields of industry, education, government and art chose the winners based on the presentation, the depth of the content on the subject "Air is Life", and the artistic aspect.

The quality of the submissions and the passion with which the students carried out their work was exceptional, according to Matthias Kasprovicz, Managing Director TROX Middle East LLC.



Professor Albert Fakhoury, Chairman of the Department of Interior Design

TROX Middle East honoured three times



# Art worth billions.

## Art as an economic factor.

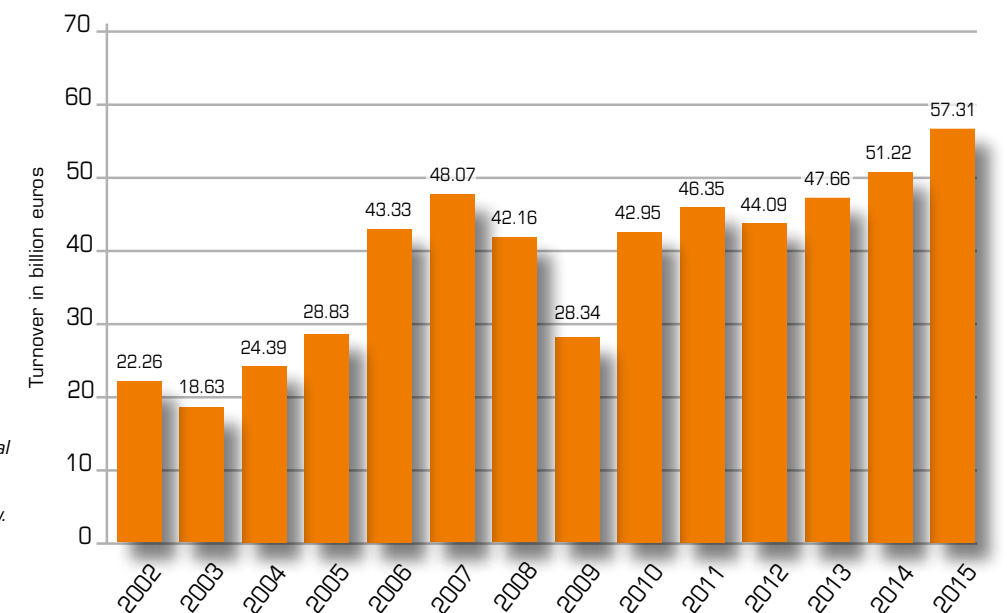
The Scotsman James Christie swung a gavel for the first time in 1776, when he still had very little interest in art. Pigs, chickens, manure, rare birds, tulip bulbs, hay bales, bed sheets, duvets and a specially produced coffin were among his first items up for auction. Just one year later – thanks to good relationships with the artistic and intellectual elite – his range was extended to include works of art. Today, Christie's company has a worldwide network of 2500 employees and generates an annual turnover of 5.7 billion euros.

The global art market, comprising some 300,000 dealers worldwide, is worth around 60 billion euros and is more lucrative than many conventional industries. Auctions in 2015 saw works of art being sold at peak values: Pablo Picasso's "Les femmes d'Alger" (179 million US dollars), Amedeo Modigliani's "Nu couché", (170 million US dollars) and Alberto Giacometti's "L'homme au doigt" (141 million US dollars). The majority of the sales revenue is achieved by older pieces. Very few living artists such as Jeff Koons, Gerhard Richter or Jasper Johns are able to achieve earnings in the millions, but contemporary art is becoming increasingly popular with collectors.

Alongside auction sites, art exhibitions such as Art Basel, the most important international fair for contemporary art, have established themselves as art trading centres – meeting points for the rich and the beautiful. Not only will you find actors such as Sylvester Stallone and Sarah Jessica Parker or rock stars including Lenny Kravitz wandering around, the numerous people in white thawbs strolling through the aisles will also make you think you have been transported to the Middle East. And as art is a notoriously ideal way to launder money, wealthy visitors may well be representing "the company".

However, it is a myth that art as a form of investment achieves staggering rates of return. An investigation carried out by the University of Luxembourg showed that, between 1972 and 2010, paintings of all styles and eras yielded a 6.5% return on investment on average – before costs. In an auction, however, a buyer can be subject to a premium of up to 25%. This means that it takes five years to break even. Of course, there are exceptions that prove the rule: Eric Clapton earned 26.5 million euros at auction in London for Gerhard Richter's "Abstraktes Bild". For the rock musician, this was a deal which more than paid off: he had "only" paid a total of around 2.6 million euros for the painting plus two others in 2001.

Turnover in the global art market in the years 2002 to 2015 (in billion euros)



These statistics show the value of global sales on the art market between the years 2002 and 2015. In 2002, sales amounted to 22.26 billion euros globally.

Source: statista





# The TROX Principle. Focus on people.



People and their well-being are at the centre of our business. This is why we are committed to creating intelligent ventilation and air conditioning systems, which not only provide maximum comfort, safety and reliability, but which are also energy-efficient. With this in mind, we designed the TROX booth for ISH 2017, which took place in Germany recently. In addition to many new, innovative products, we also presented application-oriented system solutions, designed to improve the well-being of people in buildings.



The TROX Principle at ISH

**Adaptable systems.**

System solutions ensure that interconnected ventilation and air conditioning components respond to changing requests – in real time and based on demand. This is possible because the relevant parameters are continuously measured so that the setpoint values can be maintained. At ISH in Frankfurt, TROX presented intelligent system solutions developed to meet the specific requirements of selected types of building.

- Hygiene and safety, e.g. in a hospital
- Comfort conditioning systems, e.g. for offices
- Fire and smoke protection, e.g. in a shopping centre
- Clean room conditions, e.g. in a lab

**Ventilation systems for the most demanding hygiene requirements.**

Air hygiene has the highest priority in the medical sector. Room air contamination must be minimal at all times, and critical limits must not be exceeded at any time. In addition, germs, dust, anaesthetic gases and odorous substances must be contained and removed safely. Hospitals present a complex challenge to control systems since pressure, temperature and air quality may have to be different for every single room.

X-CUBE air handling units with the integral X-CUBE control system and high-efficiency particulate filters ensure that the demanding requirements of hospitals are met. They are specifically designed to meet those high requirements, and X-CUBE control is easy to install and runs reliably.

**Comfort conditioning systems.**

Good indoor air quality is not only conducive to the well-being of the occupants, but also increases their performance.

X-AIRCONTROL ensures the smooth interaction of all the components such that good air quality is maintained. Sensors measure occupancy, air quality and temperature, and the measured values are used to condition the indoor air based on demand. Zone master modules allow for expanding the system and provide interfaces to the central BMS and for remote maintenance. X-AIRCONTROL is very flexible and thanks to plug and play also easy to install and set up.

**Safety systems for fire and smoke protection.**

In fire and smoke protection, it is 'safety first'. In the event of a fire, it is essential to save lives. This requires sophisticated safety systems with components that are perfectly complementary to one another. The TROXNETCOM intelligent control system links fire and smoke protection dampers, smoke control dampers, volume flow controllers, duct smoke detectors, and smoke exhaust and ventilation fans to create a system of superior reliability. It makes sure that the individual system components communicate with one another, while system conditions are monitored and the necessary parameters are adjusted immediately.

**Air management systems for sensitive areas.**

In sensitive areas such as labs, where work safety and the protection of people and the environment are priorities, it is of paramount importance that all components complement one another perfectly. This is why air management also has the principal task of creating conditions that meet these requirements reliably and efficiently. The LABCONTROL control system features very short response times. Where aggressive substances are being handled, sensitive areas are separated from other areas by different pressure levels, i.e. negative or positive pressure.

There is now a new explosion-proof X-CUBE air handling unit for use in areas with potentially explosive atmospheres.



Perfect integration in ceilings: PURELINE slot diffusers

**Innovative products.**

In addition to innovative systems, we also presented innovative enhancements of existing products. We will introduce only two of them here, but you will find more information in our next issue.

The PURELINE slot diffusers have aerodynamically optimised air control elements, the result of extensive research (see also p. 15). Many series of tests and innovative prototyping have led to a product that creates comfortable levels of ventilation, has excellent acoustic properties, and leads to much less contamination of the ceiling. The diffusers blend in perfectly with any ceiling thanks to their unobtrusive appearance.

The multileaf EK-JZ smoke control damper is installed in the walls of shafts that are used for smoke extract. It is ideally suited to keep stairwells free from smoke when a pressurisation system is used. High-temperature resistant EK-JZ dampers include an innovative two-level sealing system, which ensures tightness with high and low temperatures. More about this in our next issue.

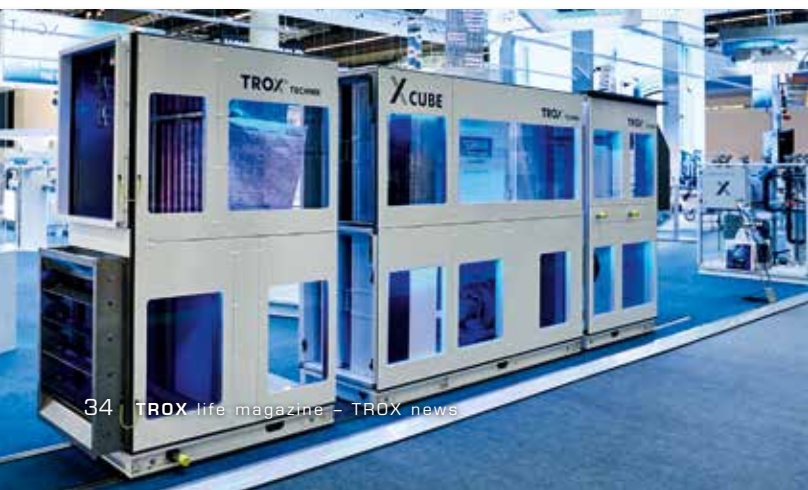
X-CUBE with X-CUBE control

X-AIRCONTROL is used to condition the indoor air based on demand

Explosion-proof X-CUBE air handling unit

TROXNETCOM

EK-JZ fire dampers



# In conversation with Prof. Dr. Fleisch, Chairman of the Heinz Trox Foundation.



ISH, Frankfurt: Lively discussion at the TROX booth, with Prof. Dr. Hans Fleisch, Kilian Reichert (moderator), TROX CEO Udo Jung, and Prof. Dr. Dirk Müller of RWTH Aachen university (from left to right).

Heinz Trox passed away on 1 October 2015. He turned TROX into a global market leader with more than 3700 employees and achieved a turnover figure of almost half a billion euros. After his passing, his 85% of the company shares were transferred directly to the Heinz Trox Foundation. These are now being managed by the foundation council, which is headed up by its Chairman, Professor Dr. Hans Fleisch. We talked to him about the ways in which the company is moving forward without Heinz Trox and the future focus of the company.

**Professor Fleisch, Heinz Trox embodied everything that the company stands for. How will the company move forward as he intended?**

His spirit is still with us. And our actions continue to be shaped by his principles:

- We are loyal to the location and our employees.
- We do honest work, act according to strict compliance principles, and – quite simply – aim to achieve quality.
- We place great emphasis on research and development in order to hold our own in a highly competitive market.

**What has changed in the time since the passing of Heinz Trox?**

Responsibility and decisions used to fall to him alone. Now, however, there are changes taking place in TROX's corporate culture. Responsibility has been placed on many shoulders instead:

- Our managers have more responsibility and receive support in bringing forward their own innovative ideas regarding strategy and processes in the company.
- Decision-making processes are now more heavily determined in a collaborative manner than before.
- The foundation council and the Supervisory Board

are involved in important decisions; for example: how can we continue developing globally and which products should be integrated into our range?

- We want to increase the profitability of the company in order to ensure stability and security.
- And last but not least, we are accelerating our transformation into a systems provider – but without neglecting the solid foundation represented by our components business.

**You have been the Chairman of the Foundation since October last year. What is the purpose of the Foundation?**

The fundamental concern of the Foundation is to ensure the continued existence of the company and its location. Our charitable aims are to promote scientific work in the area of ventilation and air-conditioning technology, and to support social and cultural activities that are in keeping with the statutes of the foundation. As the foundation council, we are, so to speak, the guardians of these aims and we are involved in important decisions.

"The human being is the yardstick and his well-being is our goal." These are the words used by Heinz Trox to describe his entrepreneurial activities. The foundation bases its activities on these words by sponsoring scholarships, for example, and supporting fundamental interdisciplinary research which focuses on the improvement of human well-being indoors.

With this in mind, we established Heinz Trox Wissenschafts gGmbH, which became active on 24 August 2016 in close cooperation with RWTH Aachen University and aims to promote science and research.

To be clear, this is not an outsourced TROX research and development division. Instead, it represents our desire to encourage research endeavours and conversation on the subjects of climate and ventilation. The goal is to improve indoor air quality in buildings and to raise the general public's awareness of the subject both nationally and internationally.

And lastly, the market – and TROX as a result – will naturally benefit indirectly from this kind of research initiative.

**Please could you explain the room air conditioning system concept?**

Since we have an almost fully comprehensive range of components and units for ventilation and air-conditioning technology, we can offer our customers room air conditioning solutions entirely from a single source. What's more, we provide the very highest standards of quality and safety, something which has been confirmed by our customer satisfaction analysis.

The trick is therefore to link the ventilation and air-conditioning technology components in an intelligent way, which means networking optimum performance and energy-efficiency with maximum effect.

**Which measures have been introduced by the new Board of Management specifically with the aim of increasing revenue?**

It is important to note at this point that Heinz Trox led the company very selflessly in the past. Profits were retained and continue to remain in the company, with the exception of moderate contributions to the Foundation. Technical advancements and innovation have a higher priority than the distribution of profits.

We are obligated to achieve a sufficient amount of profit in order to ensure the long-term existence of the company and to remain competitive. With the "X-FIT" programme, our management has defined clear goals relating to cost savings and increasing efficiency by 2020.

**Could you tell us a little about your career?**

I studied law at Tübingen and Göttingen in Germany. After I had spent a few initial years of my career at the financial services company Allianz, it was my involvement in foundations that shaped my professional career. I headed up the

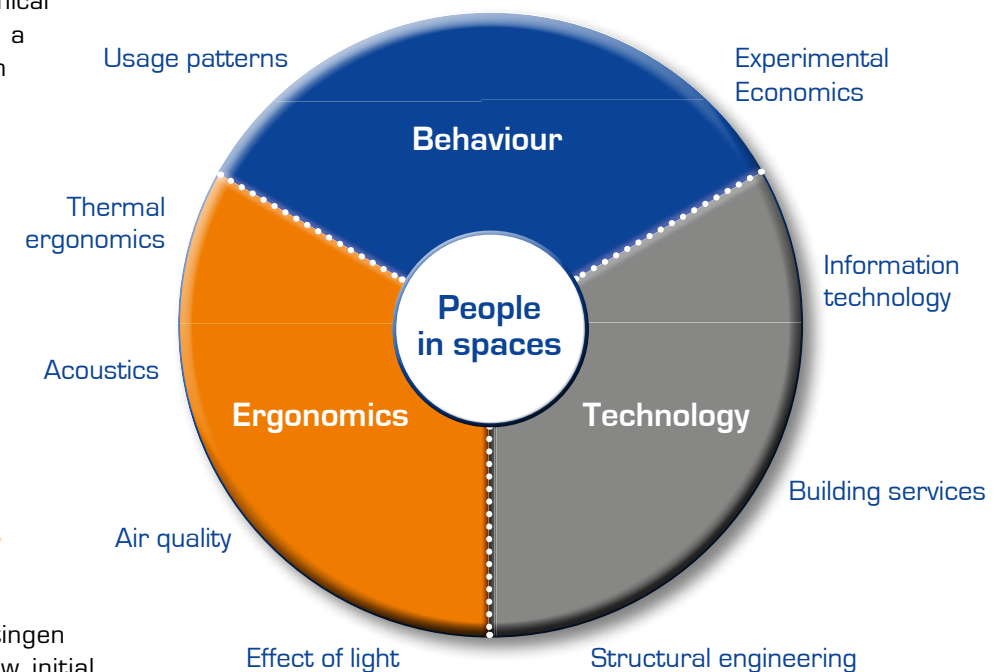
German Foundation for World Population, for example, and was the General Secretary for the Association of German Foundations. For a number of years, I have been teaching foundation management as an honorary professor at the University of Hildesheim and the German Foundation Academy. I also volunteer on various boards of institutions serving scientific and social purposes. In 2000, I founded the Berlin Institute for Population and Development, and chaired this until 2006.


**Where do you find space to relax after so many commitments?**

My ideal way to relax is spending time with family, either growing vegetables at our farm or during one of our many canoe trips.


Thank you for talking to us, Professor Fleisch.

Research areas and topics of Heinz Trox Wissenschafts gGmbH





**Roarrrrr!  
Brrmmm! Plopppp!  
Click! Shsssh!  
Chirp!  
While my car  
gently tweets.**



The automotive sector no longer leaves anything to chance when it comes to sound. Acoustics designers work meticulously to achieve a sound that signifies the brand.

The sound of the car.

Alongside appearance (80%), a sound that is typical of the brand (44%) has become a significant buying criterion when purchasing a car. This is why companies have long been leaving nothing to chance when it comes to the sound of a vehicle. Hundreds of sound designers compose and orchestrate the typical sound of a car brand in their sound studios. They conduct experiments using the engine and wind sounds that are emitted during driving and create a sense of emotion for the driver – and that’s not all. They also work on the sound of the horn and the indicators, and the noise made when closing doors or the boot. For the latter, a deep, dull plop sound is intended to create a feeling of security and quality, while the indicator sound is reminiscent of the classic clicking of the relay from the 50s and 60s.

Acoustic design in the automotive sector is a difficult research discipline, and there is a whole range of different sound-emitting elements in a vehicle whose resonance levels must be managed in order to achieve the desired sound experience.

Gone are the days of the VW Beetle emitting its natural ticking sound or wailing because its V-belt is grinding. Nowadays, its sound emissions are more sophisticated. Even the hyena-like noises of an NSU Quickly would no longer accommodate the tastes of today. The Vespa remains the only example in which time seems to be standing still. It still chatters along in the typical Mediterranean way, with boisterous and raucous sounds that penetrate the narrow streets of Italian towns and villages.



Electric cars were developed in order to reduce exhaust fumes and noise pollution in the environment. But there’s no denying the irony they have created in the process: in the USA, it has been identified that electric cars have caused twice as many accidents as their conventional counterparts when starting up and parking. As a result, they will be provided with sound in the future. This will require them to be fitted with an Acoustic Vehicle Alerting System, which makes sound similar to that of a combustion engine. It switches on automatically when starting up and remains on until a speed of 20 mph is reached. At higher speed ranges, air resistance and rolling noises ensure that electric cars can be heard. This does, however, mean that Japanese sound designers can no longer pursue the idea of electric cars emitting bird-like chirping noises. We can tell – and hear – which way the wind is blowing here. But for now, it remains a distant vision in Tokyo’s smog-cloaked streets.



Sound artists are restricted when it comes to noise levels, however. In Germany, for example, it is illegal to exceed the specified limit of 74 decibels – a fact which amateur sound designers love to ignore. How else can you explain the way our coffee cups regularly vibrate on Sundays when souped-up motorcycles rev their engines at traffic lights two hundred metres away? ROaaR!

**Credits:**

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