L-ACOUSTICS SOUND SOLUTIONS:
PERFORMING ARTS CENTERS
INTRODUCTION

When the founder of L-ACOUSTICS, Dr. Christian Heil, invented the V-DOSC system - the very first line source system featuring the exclusive WST® technology in 1992 - it revolutionized the professional audio industry.

Since 1984, a large body of theoretical research and experience is behind every system that L-ACOUSTICS develops. Today, L-ACOUSTICS sound systems are considered the #1 choice for internationally recognized venues ranging from the Hollywood Bowl, the Beijing Opera House, the Olivier Theatre, part of the National Theatre, in London, and countless other facilities worldwide.

As the live performance business continues to evolve, performing arts centers are increasingly required to provide excellence in sound reproduction, by artists, productions and audiences alike. This performing arts center brochure presents a select number of performance venue challenges and solutions tackled by owners, consultants, engineers and contractors with L-ACOUSTICS systems. From the early stages of design through to system commissioning, every performing arts sound system project presents its own unique set of constraints, objectives and challenges. With L-ACOUSTICS, we always find the solution. We look forward to delivering The Best Sound to your audiences in opera houses, theatres, live clubs and performing arts centers across the globe.

Cédric MONTREZOR
Director of Application, Install

A SOUND PARTNER FOR PERFORMING ARTS CENTERS 5

FROM THE DESIGN PHASE...
Outstanding throw - Hollywood Bowl
Directivity control - Bamboo Nightclub
360° coverage - Danish Radio Concert Hall

...THROUGH TO INTEGRATION 15
Mobile system - Olivier Theatre, National Theatre
Discrete integration - Chongqing Grand Theatre

...AND BEYOND 21
Faithful to vision - Guangzhou Opera House
Diversified productions - Salle Pleyel

REFERENCES 26
Performing arts portfolio
White papers

ENVIRONMENTAL CREDENTIALS 30
“THE TEAM AT L-ACOUSTICS AND USE OF SOUNDVISION REALLY MADE WHAT COULD HAVE BEEN AN EXHAUSTIVE PROCESS A MUCH SIMPLER METHOD LEADING TO THE PRIME SOLUTION.”

Sam Moergen, LiveSpace Project Designer - Epikos Church

Shanghai Oriental Arts Centre
DELIVERING AN IMMERSIVE CONCERT SOUND EXPERIENCE FOR EVERY AUDIENCE MEMBER.

With a good sound system, everyone enjoys the show. L-ACOUSTICS’ number one goal is to create an unprecedented sonic experience for the audience, with easily reconfigurable and widely accepted sound systems.

Combining breathtakingly high-impact sound reinforcement with stunning transparency, our systems “disappear” behind artistic performances, providing a truly immersive experience for the audience. Our high-quality systems allow performing arts centers to become truly multi-purpose venues, with the potential to create or enhance revenue streams.

How is this achievement possible? L-ACOUSTICS has been designing reference line array systems for more than 20 years. Our exclusive technologies, providing enhanced directivity control, allow L-ACOUSTICS to:

• provide consistent Sound Pressure Level, and sonic experience, to every audience member

• enhance the intelligibility of the system, ideal for spoken word messages

• offer energy savings and system set-up flexibility

L-ACOUSTICS speakers focus all of their sonic energy on a particular segment of the audience. This reinforces an exceptional preservation of the acoustics of your venue.
“IT GIVES YOU A GREAT SENSE OF SECURITY TO KNOW IN ADVANCE HOW YOUR INVESTMENT IS GOING TO PERFORM, AND EVEN BETTER WHEN IT PERFORMS EXACTLY AS WAS PREDICTED ON SOUNDVISION.”
Christian Savad, Technical Head at the Musikhuset Esbjerg - Esbjerg Performing Arts Centre
POWERFUL ACOUSTIC SIMULATION TOOLS

L-ACOUSTICS has developed a powerful design tool dedicated to the needs of consultants and system contractors. SOUNDVISION projects® sound simulations according to the physics of light, creating a visual representation of your “sound vision”. L-ACOUSTICS SOUNDVISION is the first real time 3D sound design program capable of “showing” sound sources as if they were light projections. SOUNDVISION allows sound designers to visually design and optimize the performance of L-ACOUSTICS sound systems (in performing arts centers). This intuitive “what you see is what you get” visual approach provides the greatest speed and accuracy in:

• predicting and adjusting the sound design according to the exact geometry of the facility

• providing equipment options to balance between sound pressure level and budget

FLEXIBLE MECHANICAL DESIGN

All L-ACOUSTICS sound systems are engineered to be adapted to any environment and come with a rigging system that does not require any additional mechanical development. The rigging, derived from our touring systems, enables system mobility for special productions, fixed installation mechanical calculations, and quick reconfiguration whenever needed. The mechanical behavior of the sound system is integrated into SOUNDVISION. This enables a fast, predictable and secure mechanical simulation that consultants and system integrators can rely on. With L-ACOUSTICS, the design phase of a sound system for performing arts centers brings an unprecedented level of predictability alongside the maximum efficiency.

* L-ACOUSTICS can provide electro-acoustic modules to offer compatibility with third party software such as EASE, CATT, LARA and ODEON.
“It literally stopped me in my tracks as I stepped out into one of the promenades… there was no discernible drop in dynamic range, volume or quality.”

Paul Geller, Production Director - Hollywood Bowl

LOCATION
Los Angeles, USA

CAPACITY
18 000

EQUIPMENT LIST
- 32 x K1
- 8 x K1-SB
- 8 x KARA
- 8 x ARCS II
- 16 x SB28
- 8 x KARA
- 12 x 5 XT
- 30 x LA8
- 4 x LA4
CHALLENGE

**Hollywood Bowl** is a famous outdoor venue, with an audience capacity of 18,000 across a 450 feet (137 meter) incline. This spectacular audience depth presents a major coverage challenge. The system must throw high frequencies far into the distance. It must also control the differential attenuation of low frequencies, which tend to progressively thin out the tonal balance towards the outermost seats. Finally, the noise pollution of the system must be reduced to a minimum in the urban Hollywood location.

SOLUTION

The LA Philharmonic board oversaw a blind comparative evaluation of leading manufacturers. The L-ACOUSTICS K1 line source system was chosen unanimously, bringing additional SPL and a smoother horizontal coverage. The left and right line sources of 16 x K1 were optimized by a further 4 x K1-SB LF enclosures to control and throw the LF contents. The radiation pattern of low frequencies is squeezed vertically projecting acoustic energy to the back of the audience.

RESULTS

The K1 line source system provides 105 dB of max SPL (102 dB on the previous system) on 95% of the audience depth with a tolerance of 3 dB. The tonal balance measured from the front seat positions shows an LF contour of 15 dB. In addition, the superior control of HF dispersion contributes to an additional 6 dB of rejection over the previous system, contributing to a significant reduction in noise pollution to the surrounding neighborhood.
“Bamboo Club knew they wanted the L-ACOUSTICS brand because all of the world’s top DJs - including Tiesto, Avicii, Swedish House Mafia - request it as their first choice.”

Nick Assunto,
CEO - Audio Formula

LOCATION
Miami Beach, USA

CAPACITY
1,200

EQUIPMENT LIST
14 x KUDO
10 x SB28
4 x ARCS WIDE
6 x 12XTi
2 x SB18
6 x 5XT
10 x LA8
2 x 112P
2 x SB15P
CHALLENGE

Bamboo Nightclub, with a standing capacity of just 1200, wished to create the live experience of a large concert venue, helping to attract the very best talent amongst the top world class DJs. The sound system had to be capable of handling both concerts and DJ performances, delivering high SPL levels and a LF tonal balance capable of handling both rock and electro program material. The highly reverberant space was a major acoustic challenge.

SOLUTION

The main L/R concert system consists of 4 x KUDO variable curvature line sources with adjustable K-LOUVeR horizontal directivity and 4 x cardioid SB28 subs on each side of the stage frame. Opposite the stage two additional clusters of 3 x KUDO are activated for DJ performances. Additional 6 x 12XTi and 4 x ARCS WIDE delays cover the rear audience area while 2 x SB28 are hidden underneath the central catwalk for infrasonic reinforcement.

RESULTS

The KUDO/SB28 sound system delivers high SPL, spectacular impact and LF contour. A low reverberation time is maintained by the KUDO K-LOUVeRS, avoiding the highly reflective marble tiles and LED walls. In the LF region the cardioid configuration of the SB28 subwoofers minimizes the room excitation. Both DJs and bands have been impressed with the performance of the sound reinforcement. The club has quickly become one of Miami’s most popular “buzz” venues.
360 DEGREE COVERAGE
DANISH RADIO CONCERT HALL

“The sound system covers a complex audience geometry with an identical and transparent acoustic signature for every seat.”

Erik Falck,
Technical Director - Matrix Sales

LOCATION
Copenhagen, Denmark

CAPACITY
1800

EQUIPMENT LIST
6 x KUDO
32 x KIVA
12 x KILO
8 x SB118
5 x 115XT HiQ
4 x 12XT
6 x 8XT
3 x LA8
10 x LA4
CHALLENGE

The Danish Radio Concert Hall is a multi-purpose venue, providing a home for the Danish National Radio Symphony Orchestra. The 1 800 capacity audience wraps 360° around a center stage in a complex patchwork of multiple asymmetric seating arrangements. The acoustician added reflective surfaces to modulate the reverberation time from 1.5s to 1.9s (when the venue is occupied), creating an additional challenge.

SOLUTION

The system is configured with front, rear and side sound sources located in the ceiling and flown on the canopy at a height of approximately 15 m above ground level. The audience coverage is divided into seven horizontal sectors (one 60° mono KUDO cluster for the front audience and six 50° KIVA clusters) which overlap to recreate stereo imaging. With different cluster sizes determined by the vertical coverage requirements, SPL and tonal balance homogeneity is addressed by adjusting inter-element angles between cabinets and the L-ACOUSTICS DSP array morphing tool.

RESULTS

The listener experiences the same tonal balance and identical SPL level from each of the line sources located around the concert hall. The sound system is also totally transparent, respecting the acoustic signature of Nagata Acoustics. The line sources offer a high vertical SPL rejection outside of the coverage area, preserving the stage and maintaining a high immunity to feedback. The horizontal directivity of KIVA of 90° contributes to a 30° overlap between zones for better sound spatialization.
“THEY TOOK PHOTOS AND MEASUREMENTS OF THE VENUE, AND THEN GAVE US SEVERAL POTENTIAL SYSTEM DESIGNS TO CHOOSE FROM. IT MADE IT EXTREMELY EASY TO SHOW MANAGEMENT HOW AN L-ACOUSTICS SYSTEM WOULD OVERCOME THE OBSTACLES AND CHALLENGES THAT OUR PREVIOUS SYSTEM HAD FAILED TO ADEQUATELY ADDRESS.”

Chris Weathers, Production Director - Live Nation Central Region
A NETWORK
OF CERTIFIED SYSTEM INTEGRATORS

L-ACOUSTICS carefully selects certified system integrators. Our System Integrator Charter outlines three key commitments:

• tailored services from specification to post-integration stage

• adoption of recommended technical standards to ensure the consistency and predictability of performance and operational safety of the sound system

• in-house trained personnel on multiple aspects of integration of L-ACOUSTICS

L-ACOUSTICS certifies its system integrators with official training seminars. Technical and engineering personnel are trained on theory, sound design, system set-up and rigging procedures for all systems.

STANDING BEHIND EACH PROJECT

L-ACOUSTICS stands behind the integrators and the consultants for every single installation project, from project analysis, system specification, engineering, integration, commissioning and maintenance services ensuring that the system will work at its best. L-ACOUSTICS clients benefit from dedicated L-ACOUSTICS manufacturer support.

Performing arts centers can expect the highest quality of service, whether the project is design built by an integrator or specified by a consultant and awarded through a bidding process.

STREAMLINED INTEGRATION

With 30 years of designing touring systems, L-ACOUSTICS manufactures turnkey sound systems with an integrated rigging approach and an architecturally-friendly RAL color program. No custom rigging is required to install an L-ACOUSTICS sound system, which dramatically reduces design and installation time. L-ACOUSTICS amplified controllers provide an EQ station, control and monitoring, DSP processing, and limiters all in one package, providing a full plug and play system for straightforward integration.
MOBILE SYSTEM
OLIVIER THEATRE, NATIONAL THEATRE

“The Olivier Theatre is an extremely tricky theatre for sound. I was knocked out when I first heard the KARAs in this space. The sound is superbly detailed, and the system is extremely powerful.”

Paul Arditti,
Theatre Sound Designer

LOCATION
London, UK

CAPACITY
1 160

EQUIPMENT LIST

- 6 x ARCS II
- 18 x KARA
- 6 x SB18
- 8 x 8XTi
- 2 x 12XTi
- 8 x LA8
CHALLENGE

The Olivier Theatre, named after the National Theatre’s first Director, Laurence Olivier, is one of the most prestigious producing theatres worldwide. As a production house, luminaries of sound design take responsibility for each production, imparting their theatrical sound design stamp on the venue. The new sound system had to be mobile enough to be reconfigured production after production and to offer maximum flexibility to support the artistic vision of the guest sound designers.

SOLUTION

A sound system “toolbox” based upon two technologies is provided. The reproduction of vocals is served by a fixed constant curvature central cluster of 6 x ARCS II (completed by a ring of 8XTi balcony delays) with a horizontal coverage of 135°. A mobile KARA modular line source system is deployed for the reproduction of modern music in a left right arrangement of 9 x KARA enclosures with 3 x SB18 to deliver LF contour, impact and a highly transient response. The sonic space can be divided into different zones according to production demands.

RESULTS

With the diverse range of theatre the Olivier produces and the need to cater for the requests of the world class sound designers who work there, L-ACOUSTICS have designed a flexible system that can cater for every eventuality and allow the venue to host multiple productions on a weekly basis.
“L-ACOUSTICS have always been a world-famous brand. The unique line source technology fits well into the architectural style and structure of the theatre.”

Liu Yongyao, Technical Director - Leafun

LOCATION
Chongqing, China

CAPACITY
1 850

EQUIPMENT LIST
28 x KIVA
8 x KILO
4 x 115XT HiQ
4 x SB28
28 x 108P
24 x 112P
4 x SB15P
6 x LA8
CHALLENGE

The Chongqing Grand Theatre is a landmark in the region for its striking sculptural design. The Grand Theatre is designed as a world-class venue hosting opera, dance, drama, ballet, symphony and other large-scale variety shows. The integration of the sound system had to fulfill exacting architectural constraints.

SOLUTION

In the Grand Theatre, left and right arrays, encompassing 14 x KIVA ultra-compact line source array cabinets with 4 x KILO low frequency extensions have been flown on either side of the proscenium arch. An additional 2 x 115X HiQ cabinets have also been installed on each side of the stage for infill. 4 x SB28 high-power subwoofers can be moved into different places. A fill system composed of 28 x 108P and 12 x 112P self-powered coaxials has also been installed.

RESULTS

The KIVA system provided a clean, seamless integration choice, with enhanced mobility for moving and installing the speakers according to the event taking place in the theatre. The senior designer from Muller-BBM, Mr Kuemmel said, “This is the best theatre that I’ve participated in designing in China. Despite the effects of the architectural acoustic environment or the sound reinforcement effect of the theatre, L-ACOUSTICS speakers have provided the best sound for this theatre.”
L-ACOUSTICS systems are entirely engineered and manufactured in France. The company has a presence in 60 countries, employs 200 people worldwide with 25 languages spoken by employees. Five principles are at the heart of L-ACOUSTICS culture: innovation, consistent and predictable performance, a turnkey system approach, support and education of users and the longevity and durability of systems.

“I CAN SO COMFORTABLY SAY THAT WE HAVE THE FINEST SOUNDING SYSTEM IN THE WORLD. NOBODY CAN TOP IT. I HAVE TOURED THE WORLD WITH THE PHILHARMONIC FOR YEARS PERFORMING JUST ABOUT EVERYWHERE ONE COULD IMAGINE AND I’VE NEVER HEARD A SYSTEM THAT COMES CLOSE TO THIS.”

Paul Geller, Production Director - Hollywood Bowl
REVENUE GENERATION
A high performance and flexible sound system contributes to revenue generation. Offering a high impact, immersive experience attracts more audiences, artists and productions. Multi-use facilities can appreciate easy-to-reconfigure L-ACOUSTICS systems. Access to L-ACOUSTICS Rental Network inventories means that additional components can be easily sourced for diverse productions needs, reinforcing multi-strand revenue stream potential.

LONG TERM INVESTMENT
L-ACOUSTICS systems boast an exceptional durability. For over 30 years L-ACOUSTICS systems have been used as touring and live performance systems on a daily basis in challenging environments. Our earliest clients, including for example, Le Palais des Congrès de Paris or the Lille Grand Palais, have been enjoying their V-DOSC sound systems for more than fifteen years. V-DOSC continues to deliver outstanding performances today. All L-ACOUSTICS systems come with a warranty of five years.
This sound reinforcement system provides a perfect reproduction of natural and electro-acoustic sound that works very well with various types of large-scale performances”

Wilson Zhao, Supervisor of Sound - Guangzhou Opera House

LOCATION
Guangzhou, China

CAPACITY
1,804

EQUIPMENT LIST

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<tr>
<th>Quantity</th>
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<td>SB28</td>
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<td>dV-DOSC</td>
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<td>2 x</td>
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<td>LA4</td>
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<td>14 x</td>
<td>LA8</td>
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CHALLENGE

The Guangzhou Opera House is rated as one of the China’s top three theatres and the best-equipped performing arts center in southern China. Acoustic engineers and architects were briefed to design a space to accommodate diverse performances. Sir Harold Marshall designed a unique “encircling” grand auditorium, which continues the asymmetrical streamlined architectural design of Ms. Zaha Hadid. It features a 1.6 seconds of reverberation time when at full capacity, ideal for both symphonic and drama works. The sound system had to fit within the architectural and acoustic design.

SOLUTION

The sound system consists of 8 x KUDO and 2 x SB28 per side and a central channel of 10 x dV-DOSC line sources. The three arrays are concealed in the ceiling. Each side of the stage apron features 5 x ARCS constant curvature line sources. Fill systems feature a total of 28 x 8XT coaxial enclosures. The sound effects system consists of 33 x 12XT coaxial enclosures and 2 x SB28 subs.

RESULTS

Since its opening ceremony in June 2010, the GOH has hosted almost 1,000 shows. “Mamma Mia!”, “Cats” and “The Adams Family” have been produced alongside world opera masterpieces such as “Turandot”, “La Tosca”, “Madame Butterfly” and famous ballets such as “Swan Lake” and “The Nutcracker”. The GOH has been the subject of international recognition and praise for its exceptional acoustics, sound system neutrality, and performance.
“Having had extensive experience with L-ACOUSTICS sound systems, I am extremely happy to be responsible for operating the system in such a prestigious place.”

Sebastien Moreau, Sound Engineer - Salle Pleyel

LOCATION
Paris, France

CAPACITY
1913

EQUIPMENT LIST
12 x KUDO
9 x dV-DOSC
4 x dV-SUB
13 x LA48a
4 x 12XT
**CHALLENGE**

The Salle Pleyel is one of the most prestigious classical music venues in France with impressive art deco interiors. The current resident ensembles are the Orchestre de Paris and the Orchestre Philharmonique de Radio France. A major acoustic renovation program was implemented in the shoe-box venue between 2004 and 2006 by ARTEC. Part of this program addressed updating the sound system to diversify the venues’ income stream.

**SOLUTION**

A fixed central cluster of 9 x dV-DOSC modular line source enclosures is deployed to cover the announcements for the philharmonic concerts. For contemporary music from jazz to pop in a black box stage proscenium, a left right system composed of 6 x KUDO enclosures per side is completed by a 12XT stereo in-fill system. For higher SPL and impact, further systems of 3 x KUDO and 2 x SB28 can be added for the main parterre.

**RESULTS**

With the new L-ACOUSTICS system installed, a much wider range of applications now takes place in the venue. Salle Pleyel now hosts performances of jazz, world music as well as symphonic orchestras. Recent guest artists include Chick Corea, Herbie Hancock, Keith Jarrett, Youssou N’Dour, Patti Smith, Laurent Garnier, Goran Bregovic and Paco de Lucia.
<table>
<thead>
<tr>
<th>Venue</th>
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<td>Grand Auditorium Cultural Center</td>
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<td>National Doha Theater</td>
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*Images: Copenhagen Opera House, Copenhagen - Denmark and Suzhou Science and Cultural Centre, Suzhou - China*
<table>
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<tr>
<th>Performing Arts Center Installations Portfolio</th>
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<tr>
<td>National Grand Theater</td>
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For more reference information please visit:

- [www.l-acoustics.com/installations](http://www.l-acoustics.com/installations)
- [www.l-acoustics.com/picture-gallery](http://www.l-acoustics.com/picture-gallery)
How to know whether it is possible or not to predict the behaviour of an array when the behaviour of each element is known? Our purpose is to describe the sound field produced by arrays in such a way that criteria for “arraybility” can be defined.

**Sound Field Radiated By Arrayed Multiple Sound Sources**

AES Convention Paper #3269 - 92nd AES Convention - 1992

Of complex interference phenomena and thus opens the road to establishing the criteria for the effective coupling of sound sources and for the coverage of a given audience geometry in sound reinforcement applications. The derived criteria form the basis of what is termed Wavefront Sculpture Technology.

**Wavefront Sculpture Technology**

AES Journal - Vol. 51, n°10 - 2003

The Fresnel approach in optics is introduced to the field of acoustics. Fresnel analysis provides an effective, intuitive way of understanding complex interference phenomena and allows for the definition of criteria required to couple discrete sound sources effectively and to achieve coverage of a given audience geometry in sound-reinforcement applications. The derived criteria from the basis of what is termed Wavefront Sculpture Technology.
The Distributed Edge Dipole (DED) Model for Cabinet Diffraction Effects
AES Journal - Vol. 52, n°10 - 2004
A simple model is proposed to account for the effects of cabinet edge diffraction on the radiated sound field for direct-radiating loudspeaker components when mounted in an enclosure. The proposed approach is termed the Distributed Edge Dipole (DED) model since it is developed based on the Kirchoff Approximation (KA) using distributed dipoles with their axes perpendicular to the baffle edge as the elementary diffractive sources. The DED model is first tested against measurements for a thin circular baffle and is then applied to a real world loudspeaker that has a thick, rectangular baffle. The forward sound pressure level and the entire angular domain are investigated and predictions of the DED model show good agreement with experimental measurements.

Performance audio + intelligibility + evac = ?? a loudspeaker manufacturer’s take
Institute of Acoustics - Vol. 33. Pt. 6. - 2011
Using several case studies, L-ACOUSTICS will present working solutions to balancing high performance audio, STI requirements, and evacuation system integration through the use of line source array technology, loudspeaker monitoring, smart controller amplifiers, and network control and switching. This will serve as a launch pad for discussion of technology changes in place and in the works by performance audio manufacturers.
ENVIRONMENTAL CREDENTIALS

GREEN SOUND SYSTEMS
- L-ACOUSTICS line arrays have replaced the wall of sound from the ’80s
- acoustic energy focused on the audience, less noise pollution
- minimized acoustical interferences and electrical energy waste

MODERN ELECTRONICS
- highly efficient power supplies and sophisticated system control
- high-powered Class D amplification of LA8 electronic
- elevated energy efficiency close to 85% (versus 50% in the ’80s)

MANUFACTURING, STORAGE AND SUBCONTRACTING
Assembly plants, storage, and R&D departments are all local. 100% of our suppliers and subcontractors are located in France or Europe.
- SIMEA joinery: Alsace, France
- electronic assembly: Germany
- assembly of the loudspeakers: Marcoussis, France
- origin of speaker parts: European region
- wood: from renewable forests in Finland and Lithuania

RECYCLING
- wooden pallet recycling
- paper and cardboard recycling: systematically sorted at every workstation and collected by specialized companies
- recycling of computer equipment and consumables

LOUDSPEAKER COMPONENTS
- all metallic parts used in the loudspeakers are recyclable
- wood cabinets: no toxic product rejects
- wood: L-ACOUSTICS participates in a reforestation program for the Baltic area
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Grammy Award-winner Alejandro Sanz performing at Bamboo Miami

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