BUILDING IN SOUND

BIAMP SYSTEMS WHITEPAPER

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CONTENTS

FOREWORD

The world is getting noisier, and our health and productivity are suffering as a result.

The problem is particularly acute in built-up areas, and among the poorest social groups, who tend to live in the noisiest places. Even in towns where heavy industry is history, other noise sources have taken over: aircraft, road traffic, public address systems, alarms and the hubbub of increasingly densely packed populations have become the noise pests of the 21st century. The din persists indoors, too: poor acoustic design in many buildings results in nuisance noise reverberating, so we must speak more loudly to make ourselves heard. Today's urban environment is very much part of the problem.

And what are the impacts? The dozens of academic papers reviewed for this study show increased stress, irritability and loss of sleep amongst people exposed to even fairly modest levels of sound, mainly traffic noise. The World Health Organization estimates that noise pollution costs one million years of healthy life every year in Europe alone. In schools and hospitals, noise has equally significant impact, leading to slower learning, longer convalescences and lower work performance or productivity outcomes. Indeed, the European Union calculates a financial cost of over €40 billion ($52 billion) a year, in terms of lost working days, healthcare costs, impaired learning and reduced productivity.

We are not going to achieve a quiet world any time soon. Noise results from economic activity, and at a time of considerable financial malaise in many parts of the world, this activity is much needed. What we hope we can achieve is a widespread awareness of sound and its manifold effects on all of us.

This paper therefore calls for sound and acoustics to be given much greater consideration – by architects, interior designers and engineers, and by policymakers, public service administrators, business leaders and property investors. It argues for a truly integrated approach to sound, where acoustics, noise reduction, sound systems and content fit together to create environments which transform the productivity and health of their occupants. Even buildings with poor acoustics can be radically improved - at modest expense - with the right know-how.

This paper sets out to make the case for designing with sound, and shines a light on some trail-blazing work in this field already underway around the world. I commend it to anyone involved in the commissioning, specifying, designing and even the use, of offices, schools, hospitals, transport hubs, and any other kind of building.

Julian Treasure
Chairman, The Sound Agency
and Author of **SOUND BUSINESS**
The Sound Agency

EXECUTIVE SUMMARY

As leaders in the audio-visual industry, sound is our passion; helping organizations harness it effectively is one of our guiding principles. Yet, despite huge advances in almost every area of architecture and interior design – from natural light to ergonomics and environmental sustainability – sound and acoustics, for the most part, have remained secondary concerns. They are possibly the two most pressing issues in architecture today. This paper highlights why sound can no longer be regarded as an afterthought – the acoustics of a space have a disproportionate impact on the well-being and productivity of its occupants.

This paper is based on an exhaustive review of academic papers and reports going back some 40 years. The research examines the causes and impacts of sound on our health, recovery from illness or surgery, our ability to absorb information and learn, our productivity, and general sense of well-being.

Long-term exposure to excessive noise has been explicitly linked to the appearance or worsening of chronic conditions such as high blood pressure and heart disease. Noise has also been found to undermine productivity and hamper education.

For these reasons and others, the economic and social impacts of noise are significant: the World Health Organization has conservatively estimated the impact of noise on our health to wipe at least a million years from Europeans' life expectancy every year.[i] Put another way, each and every year, noise takes nearly a full day off the lives of every adult and child in Europe.

How is this happening? Our review has found that increasing noise levels and poor acoustics have been linked to a range of health-related complaints, from high blood pressure and heart disease (as noted earlier), to insomnia, irritability and poor short-term memory. The same issues have also been linked to longer hospital stays, longer convalescences, and is even contributing to slower educational development. More surprisingly, our review has found that these complaints can manifest themselves at far lower levels than one might expect. Moreover, many places where one would assume noise to be carefully controlled, particularly schools and hospitals, are some of the worst offenders when it comes to noise: in these environments an excess of noise, coupled with poor acoustics, actively undermine these establishments' core purposes – education and healing.

These impacts are to a large extent symptomatic of sound being treated as a secondary consideration – if it is considered at all. Generally, buildings could be better served by sound. Sound systems, where they exist, generally do not talk to each other or to other platforms such as IT or telecommunications. Health and productivity – even personal safety, in the case of voice evacuation – can be significantly enhanced by the various components of a beneficial 'soundscape' being more tightly woven together.

We looked at some of the work underway throughout the world, and the different approaches to integrating sound being used to create more agreeable environments. Some of this work revolves around 'deadening' rooms to minimize reverberation. Other efforts focus on opening 'artificial windows': using sound proactively to lower stress levels and create a more positive environment.

EXECUTIVE SUMMARY CONTINUED

It is not our objective to campaign against noise in all its forms and call for more quiet everywhere, but to bring attention to how critical sound is in our everyday life – whether we are consciously aware of it or not.

Moreover, we believe educators, policy-makers, realtors and business leaders must recognize that sound can significantly impact the well-being of a building's users. To do nothing could be costly; the right actions could transform productivity, enhance talent retention and promote a sense of well-being whose impact could be felt far beyond the balance sheet.

HOW SOUND IS MEASURED

The decibel (dB) is the most widely-used measure of sound intensity, though it is also used in other ways in electronics and optics. Measuring sound is very different to, for example, measuring voltage. What is actually measured is the pressure made by the sound on the eardrum, relative to what that pressure would be in total silence – also known as the sound pressure level (SPL).

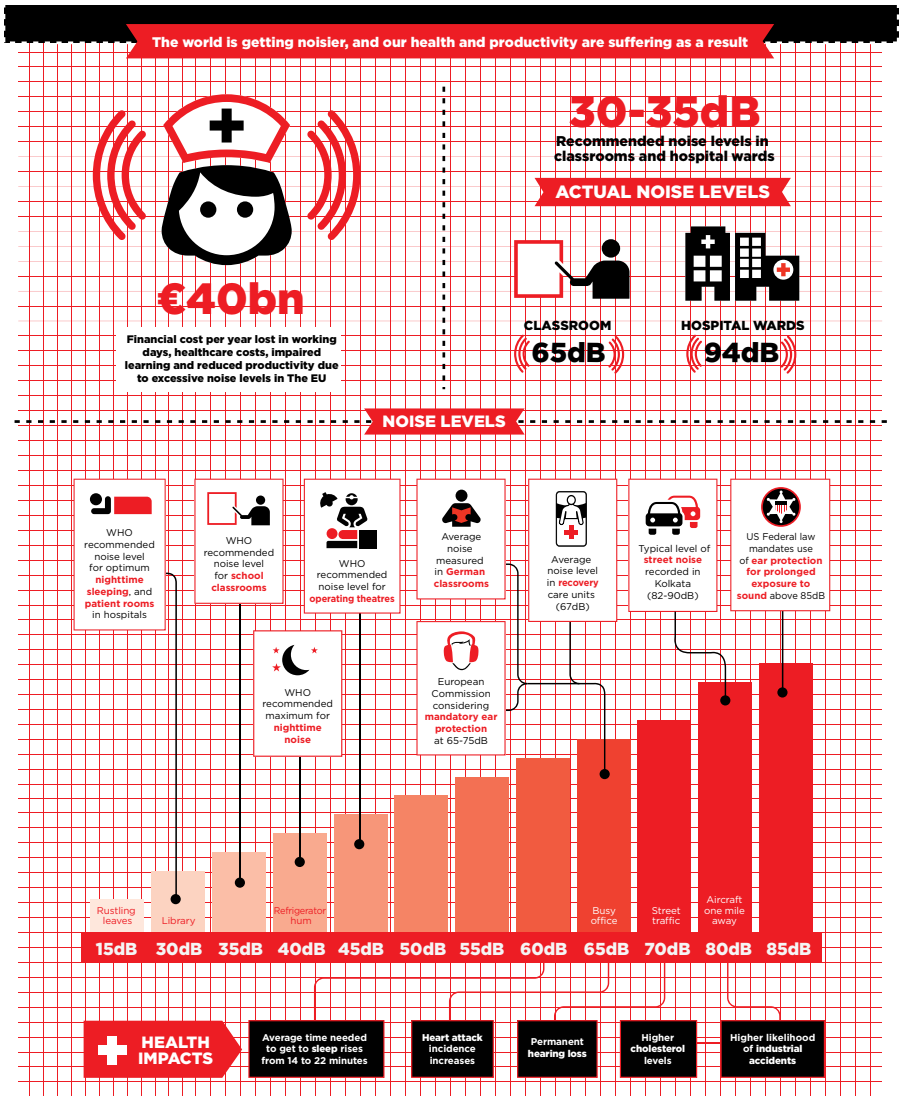
The decibel scale is logarithmic – that is, an increase of 10dB means that the sound energy has increased tenfold. An increase of 30dB implies the energy has increased by a thousand times. Our ears do dampen these effects: as a rough guide, a 10dB increase in SPL equates to a perceived doubling of perceived volume, so a 30dB increase would be perceived as eight times as loud.

HOW NOISE AFFECTS US

Noise is a natural by-product of economic growth. Our roads and skies are noisier than at any time in our history – and with relatively few checks on its growth, traffic noise has reached levels where it is dangerous to our health.

According to the World Health Organization, 40% of Europe's population is exposed to noise levels in excess of 55dB, a level at which disturbed sleep, raised blood pressure and even increased incidence of heart disease have been noted (see chart below). In large cities, the problem is even more pressing.[iii] The United Kingdom government's environmental protection watchdog found recently that around one in seven residents of the British cities of London, Manchester and Southampton were

> **The social cost** of road traffic noise is estimated to be between 30 and 46 billion Euros per year or 0.4% of GDP.
>
> **SOURCE: European Commission**[ii]



exposed continually to traffic noise above 65dB.[iv] Further, some 3% of cardiac arrest cases in Germany each year have been explicitly linked to road traffic noise.[v] By adding together the cost of lost work days, treatment of noise-related health conditions, and the productivity impact of noise, the European Commission estimates the social cost of road traffic noise to be between €30-€46 billion ($39-$60 billion) per year, or 0.4% of the region's GDP.[vi]

As a result of the growing links between road noise and cardiovascular risk, the European Commission is considering lowering the noise level at which ear protection is mandatory from 85dB to 65-75dB.[vii]

The problem of street noise appears particularly acute in the developing world. Though objective data outside of Europe and the USA is scarce, one study in the Indian city of Kolkata measured average curbside noise at 85dB, a level at which hearing loss is inevitable with prolonged exposure.[viii] With such levels of street noise it is probable that hearing impediments are already a problem across large swathes of the city's population.

Indoors, the situation is similar. The World Health Organization recommends noise levels in classrooms and hospital wards not exceed 30-35dB – roughly equivalent to those found in a library.[x] Actual noise levels are many times higher than that: one study in Germany found average noise levels in a typical classroom of 65dB (over eight times the recommended loudness), while another US study measured noise in post-operative recovery units that peaked at 94dB – what one would expect to find on a busy motorway (see chart page 6).[xi]

Both institutions generally suffer from poor acoustics, which greatly contributes to the problem. In hospitals, conversation, footsteps, clattering equipment, mechanical noises, and alarms add to the din. The impact of this noise on patient care outcome is significant.

> **A study released** by the Johns Hopkins University in July 2008 reported that the incidence of hearing loss in the United States is approaching epidemic proportions. According to this study, a staggering one in three Americans now suffers some degree of hearing impairment – much of it is noise induced.
>
> **SOURCE: George Prochnik, In Pursuit of Silence[ix]**

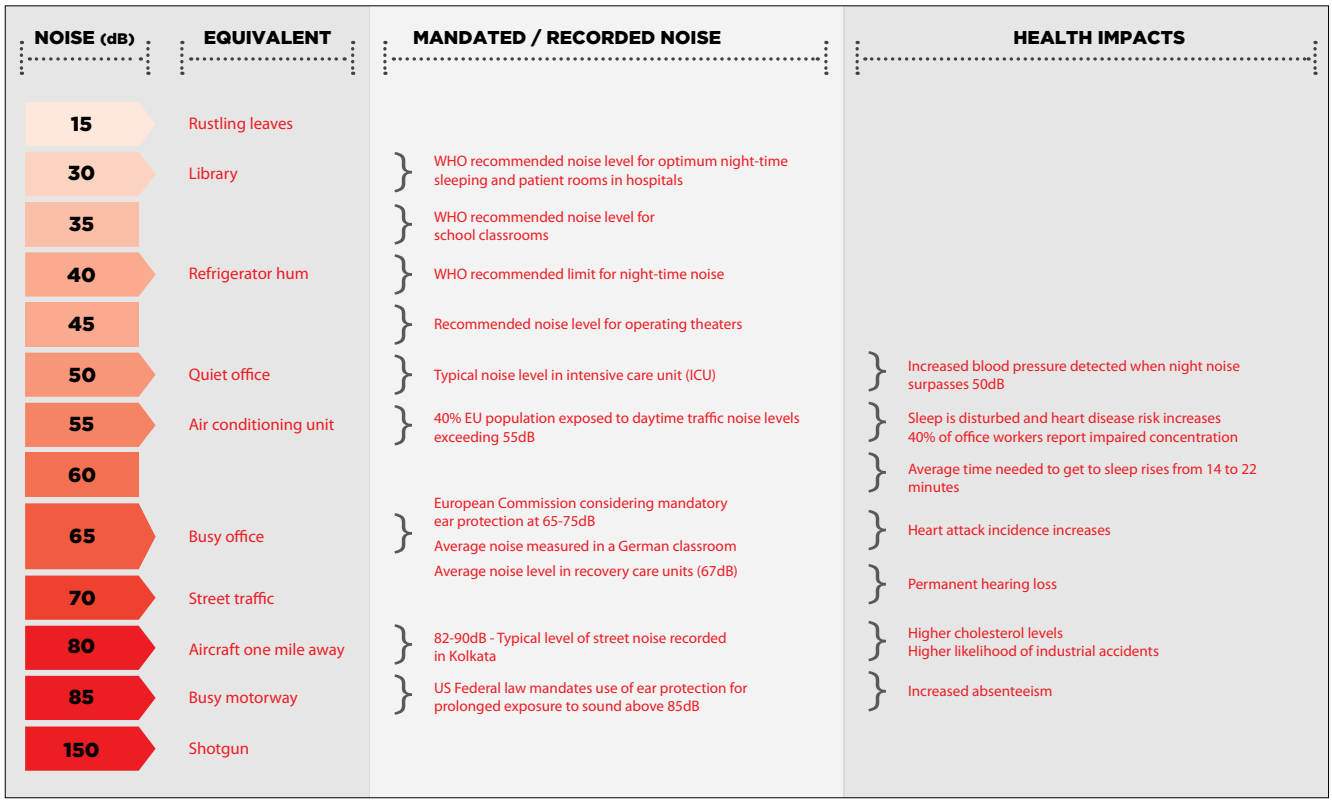
Studies in schools have found that excessive noise affects students' ability to understand teachers' spoken instructions and absorb written information. One study of primary schools in Spain, the Netherlands and the UK found that a 20dB increase in traffic or aircraft noise could delay a 9-10 year-old's reading age by up to eight months.[xii] Another problem in schools is reverberation, which not only makes speech harder to understand for students sitting at the back of classrooms, it also increases vocal strain for teachers (see box on the Lombard effect on page 7).

Evidence gathered from hospitals similarly indicates that better acoustics could have a significant positive impact on patient recovery. Studies have linked ambient noise to increased requests for pain-relief medication, slower convalescence and increased stress among medical staff.[xiii]

HOW NOISE AFFECTS US CONTINUED

The white-collar office is not immune. Though machinery noise is no longer a major source of complaint, the 'hubbub' of the now ubiquitous open plan office environment can be, in three ways. Firstly, background noise – even at low levels – has been found to increase employees' stress hormone levels and undermine short term memory, reading comprehension and willingness to help or engage with others.[xiv] Secondly, employees working in relatively noisy environments have been observed to change their posture less frequently than they would in very quiet offices. It follows that noisier offices may lead to more employee complaints and higher absenteeism, resulting from back pain and other musculoskeletal complaints.[xv]

Indeed, one study calls into question the whole notion of the productivity of open plan business offices. A survey of almost 650 employees in one building uncovered evidence of 'a variety of ambient environmental problems', particularly relating to disturbances and loss of privacy. The research found these problems were more prevalent among employees doing knowledge-intensive work than clerical staff; its conclusion is damning: "no evidence was found to support the claim for improved productivity in open plan [offices]."[xvi]



HOW NOISE AFFECTS US CONTINUED

The final point in this section relates to the one area where sound matters most of all – emergency evacuation. Where alarms and sirens have been found to cause alarm and panic, spoken instructions generally encourage safe, orderly egress. A study by Michael Creydt, a consultant in Germany, found that evacuations supported by 'voice evacuation' technology were completed 30% faster than using conventional alarms.[xvii] This conclusion is supported by a survey of UK adults carried out by Biamp Systems in early 2012, which found that one adult in ten was unaware of the escape procedure at their place of work or learning. The research found one respondent in ten did not know what their workplace fire alarm sounded like, while one third agreed spoken instructions would make them feel calmer.[xviii] Sound, therefore, does more than boost productivity and satisfaction, it can help manage crises as well.

REVERB & THE LOMBARD EFFECT

HOW WE MAKE OURSELVES SHOUT

The Lombard effect (or Lombard reflex) is the name given to the tendency we all exhibit of speaking more loudly as it gets noisier around us. It is an important consideration in acoustics, as a room's reverberation can spark a vicious spiral whereby one can feel forced to speak more loudly by the sound of one's own echo. This phenomenon generally appears at reverberation levels of 0.8-1 second (as a guide: midsize classrooms or meeting rooms may have a reverberation time of 0.4-0.6 seconds, while in a church reverberation can be as high as 3-4 seconds).

The Lombard effect is particularly detrimental in schools, as teachers must continually exert themselves to be heard, especially with modern teaching emphasizing group work rather than traditional 'talking at' class structures. One US study found that 50% of teachers had suffered irreversible damage to their voices.[xix] In Britain, one education authority was forced to make a £156,000 ($249,000) payout to a teacher who suffered permanent voice damage after several years' teaching in a classroom located next to a noisy play area.[xx]

BUILDING IN SOUND – IN ACTION

The global market for professional AV equipment was $56.4 billion (€43.6 billion) in 2009, and is projected to reach $78 billion (€60.3 billion) by the end of 2012. This is an indication that organizations are beginning to take sound seriously. Though academic research in this area is as yet patchy, compelling initial evidence linking better sound to a heightened sense of well-being is emerging. In many cases, building in sound has been linked to far more fundamental measures, including increased sales, higher employee satisfaction and lower crime rates.

In schools and hospitals, the case for building in sound has been strongly put. In the United States, sound is at last becoming established as a key ingredient of hospital convalescence (see box below). Lastly, in May 2012, the UK's Essex Study proved the effect on both educational outcomes and children's behavior of reducing reverberation in classrooms.[xxi]

> "**Integrated approaches to sound** have been linked to increased sales, higher employee satisfaction and lower crime rates."

THE ROLE OF SOUND IN HEALING ENVIRONMENTS

In response to an aging population, spending on new hospitals in the United States is expected to top $200 billion (€153 billion) in this decade.[xxii] Recognizing it is as much in their interests as the patients' to ensure fast – and definitive – convalescences, hospital operators are committing ever-greater resources to 'building a healing environment' – with sound as a key consideration.

A focus on evidence-based design (EBD) has seen hospitals borrowing techniques from complementary medicine and elsewhere with the explicit aim of helping patients feel calmer and happier, reducing stress levels among staff, and minimizing mistakes. Sound is seen as an important ingredient of such environments. A 2010 EBD survey[xxiii] found that almost half of respondents routinely implement surfaces and finishes to minimize noise, while silent paging systems were being implemented by 21%.[xxiv]

How Soundscapes Can Transform Behavior

Sound installations have found themselves at the front-line in reducing urban crime. Two initiatives in particular stand out. The first involves the city of Lancaster, California, USA, whose mayor in 2010 deployed speakers playing a mix of generative music and birdsong along a half-mile (750m) stretch of the city's main road. In its first year the installation was linked to a 15% reduction in reported crime, and a six percent reduction in serious crime.[xxv]

The second comes from the London Underground in England, which installed a sound system playing classical music at one station where crime was so rife that train drivers were unwilling to stop there. After 18 months, robberies had fallen by 33%, assaults on staff by 25%, and vandalism by 37%. Consequently, the London Underground extended the approach to some 40 stations across its network.[xxvi]

Retailers such as mall operators have seized upon the pilot sound implemented by the British Airports Authority at Glasgow Airport, Scotland, in 2006. Introduced to help alleviate stress among passengers, designed sound achieved a very tangible business outcome. A three-month trial using an ambient soundscape played in busy walkways did more than bring down stress levels – it also generated a 10% increase in sales for retailers in the airport.[xxvii]

Reducing Reverberation Makes For Better Education

A recent study carried out in the UK offers poignant proof of how acoustics could have a transformative effect in the classroom. The Essex Study (see References) explains how a number of low-cost modifications to classrooms led to teachers reporting improved behavior and involvement by all pupils, in addition to reduced stress on their own part (see box on the Lombard effect on page 7).

The modifications in question were modest: rather than playing recorded music or sound effects, the study focused on reducing reverberation by using wall-mounted boards and ceiling panels. These 'deadening' measures reduced reverberation times to half those mandated by UK government building regulations, at a cost of just £2,500 ($4,000) per classroom.

'Artificial Windows' in the Workplace

The domain where the benefits of better sound are least understood – but stand to have arguably the most significant impact – is the open-plan office. One study used 'sound masking' technology to reduce the distance at which conversation can be overheard, from around 50 feet to 15-16 feet (15 meters to 4.5-6 meters). The study found that this masking led to reported sound distractions being reduced by half, and a 47% improvement in employees' ability to focus on tasks. Short term memory accuracy was improved by almost 10%.[xxviii]

One 1979 study, focused on office workers engaged in decision making, design and other creative work, explored the effects of using sound to boost employees' sense of well-being – in a similar way to the London and Lancaster studies mentioned above. It found that 'artificial windows', comprising video projections of scenes from nature, coupled with low-level music or natural sounds, enjoyed a far more positive response than total silence from test candidates. The reasons why birdsong and other 'natural' sounds encourage well-being are deeply ingrained within the human psyche: they indicated to our early ancestors

there were no predators nearby, and humans feel the same instinct today.[xxix]

These two studies show how sound (or the lack of it) can have a tangible effect on office workers' productivity and outlook. However, a 'one size fits all' approach to sound in the workplace is clearly impractical. Instead, employers should take steps to understand which kinds of sound are most beneficial in different areas of their organizations.

BUILDING IN SOUND HITS THE MAINSTREAM

BY ROB HARRIS, GLOBAL LEADER, ACOUSTIC CONSULTING, ARUP

Fortunately, acoustic and sound system designers are now routinely employed on most major building and infrastructure projects, both public and private.

For new and realigned roads and railways, specialized computer software linked to geographic information systems (GIS) is used to quickly predict the relative noise effects of different routes. Auralization (the acoustic equivalent of visualization) allows stakeholders, including those potentially affected by the new route, to listen to what the new road traffic or railway will sound like at their location.

Within buildings, auralization is also used to allow clients, developers and designers to understand what different noise levels sound like, the effect of different sound insulation standards of partition, etc. by directly listening to what the building will sound like together, as it is being designed. This has made it much easier for acoustic designers to explain acoustic concepts to non-specialists and for considered design and expenditure decisions to be made. For example, if money is to be spent on improving the intelligibility of boarding announcements in an airport, auralization sessions can determine whether to invest in more acoustic treatment, better loudspeakers or both, by directly listening to the predicted results of each option.

Noise is "unwanted" sound. Increasingly we are introducing "wanted" sound to mask noise such as traffic noise in cities, using either "natural" sources (fountains, flowing water, wind chimes) or composed sound pieces.

Lessons From the World of IT

While the research described in this section has considered the issues of acoustics, noise reduction, sound systems, and content in isolation, it is evident that all four issues need to be considered together. The catalyst for this integration has been the accelerating 'convergence' of the worlds of IT and audio-visual (AV) equipment. IT professionals have long recognized the value of using networks to deliver IT services tailored to the needs of individual users, or groups of individuals. AV systems are following a similar trajectory – in some cases using the very same IT networks to bring unprecedented flexibility to managing and delivering digital sound not just to single spaces, but across entire campuses.

It is this 'networked' approach to building in sound that allows organizations to easily re-purpose individual spaces if their use – or the requirements of their occupants – change. The model also allows the same infrastructure of speakers, amplifiers and cables to be used for a range of purposes, from soundscapes to voice evacuation. In other words, networked audio brings the idea of 'sound reinforcement' – ensuring messages, music and other sounds are audible to larger or more spread-out audiences – within the grasp of almost every organization. This is a particularly important consideration when it comes to implementing integrated sound solutions for existing buildings, and especially those where installations are governed by third-party organizations (see Real-Life Usage box below).

The Ethernet-based infrastructure most commonly used in IT data networks is designed to be fault-tolerant, providing greater reliability than the analog cabling used in more conventional audio-visual installations. Provided the network is designed properly, single points of failure can be eliminated. What is more, fault-tolerant Ethernet architecture lends itself exceptionally well to the requirements of emergency audio systems, which require similar levels of redundancy and resilience.

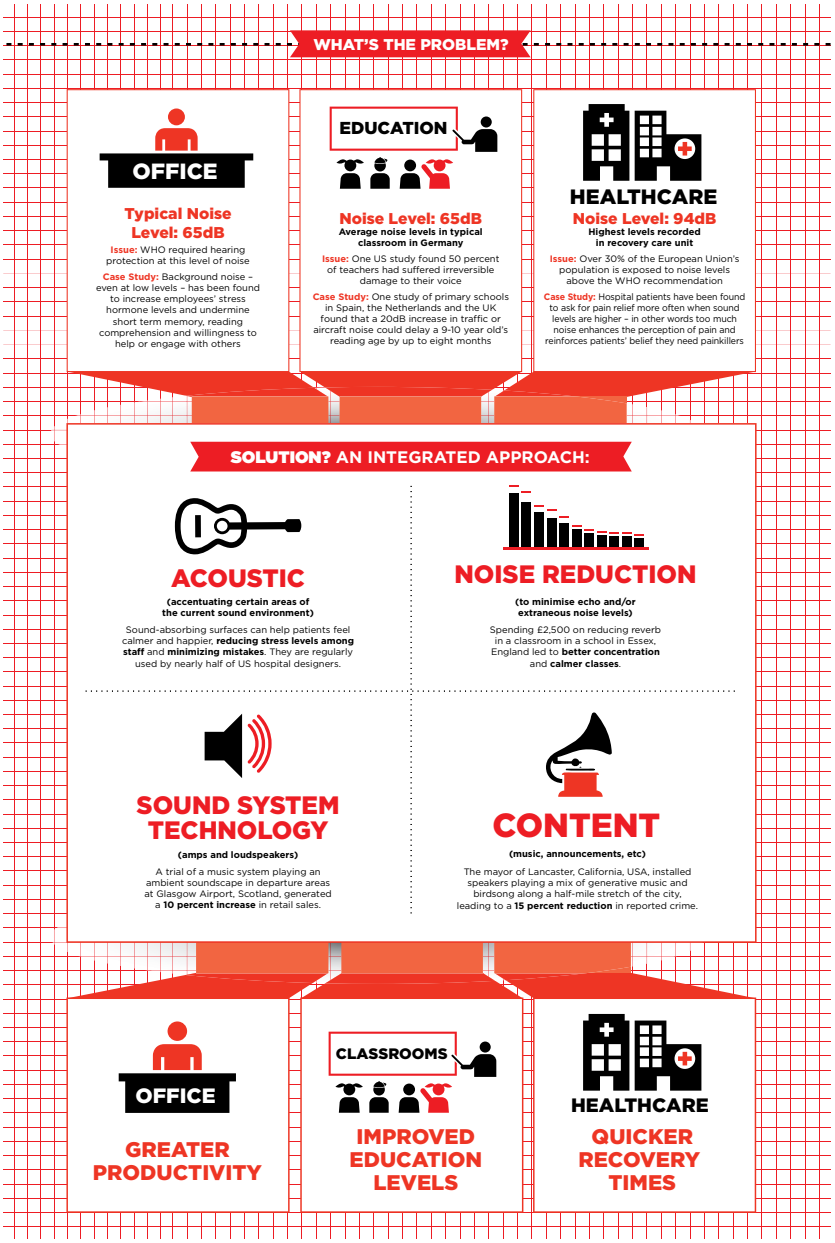
REAL LIFE USAGE

21ST CENTURY AUDIO HELPS TRANSFORM A 19TH CENTURY TREASURE OF LONDON

Located at the London terminus of the Eurostar™ cross-channel train, the Marriott St. Pancras Renaissance Hotel is one of London's most recognizable buildings. The building enjoys the highest level of protection from the UK heritage watchdog organization, so construction techniques and the materials used are tightly restricted. Any 'destructive work' – from knocking down walls to making holes for cables – was to be avoided at all costs, yet the hotel's management was keen to ensure the latest jewel in its crown was fitted out to the highest standards.

When it came to selecting audio systems for its six meeting rooms, lobbies and spa area, Marriott's contractors selected Biamp Systems' Vocia® Networked Public Address and Voice Evacuation System. Implemented by UK integrator and long time Biamp Systems partner proAV, the Vocia system allows the hotel to give guests a unique visual and audio experience: staff can set the mood in different areas using background music, while allowing meeting room users a wide choice of media sources, from iPods, MP3 players, and even telephone systems. In emergencies, staff can broadcast crystal-clear instructions across the whole network – or small parts of it.

BUILDING IN SOUND – IN ACTION CONTINUED



REAL LIFE USAGE

NETWORKED AUDIO DELIVERS THE GOODS FOR SCHAEFFLER

Schaeffler is a global leader in rolling bearings for a range of purposes. It is also an innovation powerhouse, registering some 1,100 new patents every year. Customer training and briefings are vital to its business, and to this end, it has built a brand-new 140m by 40m (460 feet by 132 feet) conference center at its global headquarters in Herzogenaurach, Germany, to act as the focal point for its showcases and customer briefings. The facility comprises some 14 multi-purpose meeting rooms and can accommodate different room configurations to meet a variety of meeting needs.

REAL LIFE USAGE CONTINUED

Biamp Systems' implementation partner Franken Lehrmittel Medientechnik Nuremberg in cooporation with FL Medientechnik Munich was selected to install and set up a sophisticated sound reinforcement system, which could not only support a wide variety of public address and audio-visual applications, but could also be used for emergency paging and voice evacuation.

Most importantly, Schaeffler required the sound system to be truly 'invisible' – physically unobtrusive and yet able to work seamlessly, regardless of how each meeting room was configured. The solution was to design a large-scale network-based audio system, based on Biamp Systems' Vocia® Networked Public Address and Voice Evacuation System, which sits at the center of an impressively sophisticated sound system. Some 430 low-profile speakers have been installed throughout, and the system can support up to 40 channels for background music. Ultimately the system provides the flexibility demanded in this highly sought after facility, while providing a reliable, all-in-one audio solution. Bernd Schindler, as representative of Schaeffler supported the installation with excellent technikcal skills and lead in finding this innovative solution, enthusiastically shares, "I'm proud of this project!"

SUMMARY: HOW TO BUILD IN SOUND

The evidence linking noise to a huge range of complaints is now unassailable, and it is encouraging to see many forward-looking organizations embarking on programs to harness sound for the benefit of all users within a building. Two developments have made these steps possible.

First, the cost, design and versatility of noise damping surfaces have improved rapidly in recent years. Features such as wall-mounted damping panels are inexpensive, can be printed on to help them blend into the office environment and, as the Essex Study shows, can have a dramatic impact on audibility and satisfaction.

Second, the emergence of IT networks as a platform for audio systems has brought an unprecedented degree of flexibility to the way sound is integrated into buildings. They make it possible to dynamically tailor the most conducive working environment to each group of individuals, and ensure paging messages are heard by, and acted upon, only by those who need to hear them (and nobody else): this is a particularly important consideration in healthcare environments, where quiet, calming environments are now recognized as key to successful recoveries. Productivity-enhancing soundscapes, emergency evacuation messages and auditorium AV systems can run off the same core platform. Any needed reconfiguration should be able to be performed from a desktop PC, rather than from the top of a stepladder.

THERE ARE FOUR INGREDIENTS OF EFFECTIVE SOUND DESIGN FOR ANY SPACE:

1. **ACOUSTICS** - These should be designed in from the start, with the help of professional acousticians, to make sure they are ideal for the room's purpose — now and for future needs. Tap interior design features such as modern sound absorbers; they can be printed with textures and patterns and look great.

2. **NOISE REDUCTION** - Consider all noise sources, especially heating, ventilation and air conditioning, computer fans, printers, telephones and simple things like the sound of furniture on flooring.

3. **SOUND SYSTEM** - Your sound system should be an extension of the quality of your brand or company, so don't value-engineer the quality out of it. Cheap systems limit options for upgrade and refinement, and low-end loudspeakers produce poor effects on people. Both elements will cost more later when you discover you need flexibility and a future-proof upgrade path.

4. **CONTENT** - Get professional help to design your soundscape, using science and art together to create something that is appropriate, flexible, and congruent with your brand and values, plus is effective in supporting people in whatever they are doing.

About Biamp Systems

Biamp Systems is a leading provider of innovative, networked media systems that power the world's most sophisticated audio/video installations. The company is recognized worldwide for delivering high-quality products and backing each product with a commitment to exceptional customer service. Industry collaboration, education and innovation lie at the heart of Biamp's philosophy. The company is a founding member of the AVnu Alliance, the industry body dedicated to developing standards for professional-quality networked audio and video systems, and it was the first US manufacturer to certify a networked audio solution as EN 54-16 compliant.

The award-winning Biamp product suite includes the Tesira® media system for digital audio networking, Audia® Digital Audio Platform, Nexia® digital signal processors, Sona™ AEC algorithm and Vocia® Networked Public Address and Voice Evacuation System. Each has its own specific feature set that can be customized and integrated in a wide range of applications, including corporate boardrooms, conference centers, performing arts venues, courtrooms, hospitals, transportation hubs, campuses and multi-building facilities.

Founded in 1976, Biamp is headquartered in Beaverton, Oregon, USA, with additional engineering operations in Brisbane, Australia. For more information on Biamp, please visit *www.biamp.com*.

About Julian Treasure

Julian Treasure is the author of the book **SOUND BUSINESS**, the first map of the exciting new territory of applied sound for business, and he has been widely featured in the world's media, including TIME Magazine, The Economist, The Times, UK national TV and radio, as well as many international trade and business magazines. His four TED talks have been viewed an estimated four million times. The first is on *the four ways sound affects us*; the second on *sound and health*; the third (which has over a million views on the TED website alone) is on *conscious listening*, and his most recent talk addresses the *importance of architects designing with their ears*.

Julian is chairman of **THE SOUND AGENCY**, a UK-based consultancy that helps clients like BP, Harrods, Helm Bank, Sonae Sierra, Nokia, Bank Muscat, Honda, Unilever, Marks & Spencer, London InterContinental Hotel Park Lane, Saga, Colgate-Palmolive, Nestlé and BAA achieve better results by optimizing the sound they make in every aspect of business – for example making sound in branding and marketing communication congruent with visuals, or designing and installing effective and appropriate soundscapes for branded spaces such as shops, offices and corporate receptions.

Julian co-authored **SOUND AFFECTS!**, an easy-to-read primer on acoustics and the impact sound can have on the way we live and work, with Biamp Systems in 2012. For a PDF copy of the book, please go to *www.biamp.com/BuildingInSound*.

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