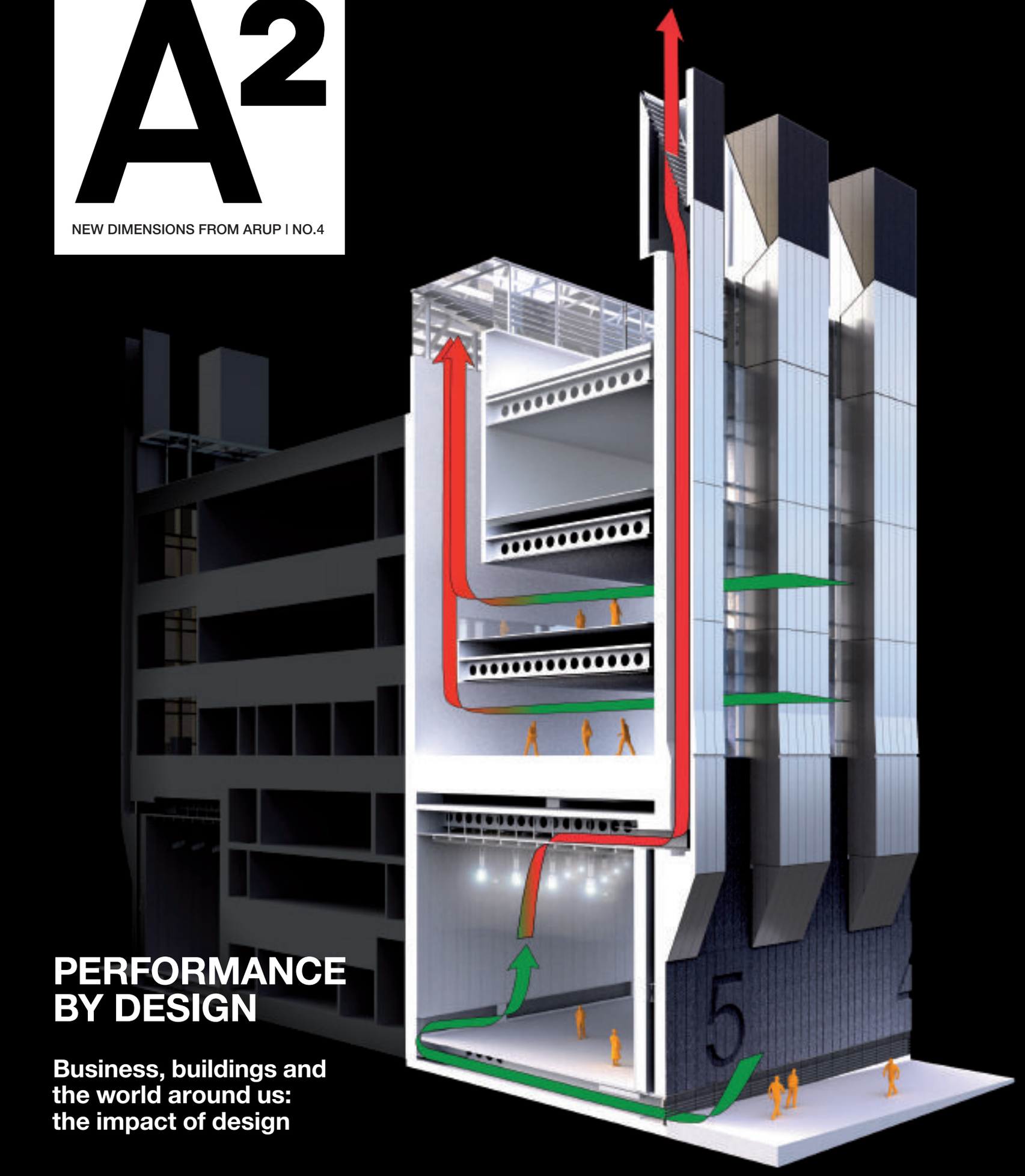
A2

NEW DIMENSIONS FROM ARUP | NO.4



PERFORMANCE BY DESIGN

Business, buildings and the world around us: the impact of design

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This edition explores the importance of good design and the role it plays in creating genuine business advantage for Arup's clients and lasting value for society. John Miles, Chairman of Global Consulting, sets the scene by exploring the meaning of "good design" and illustrating how it can lead to good business.

BUSINESS BY DESIGN

(Or the business value of original thought)

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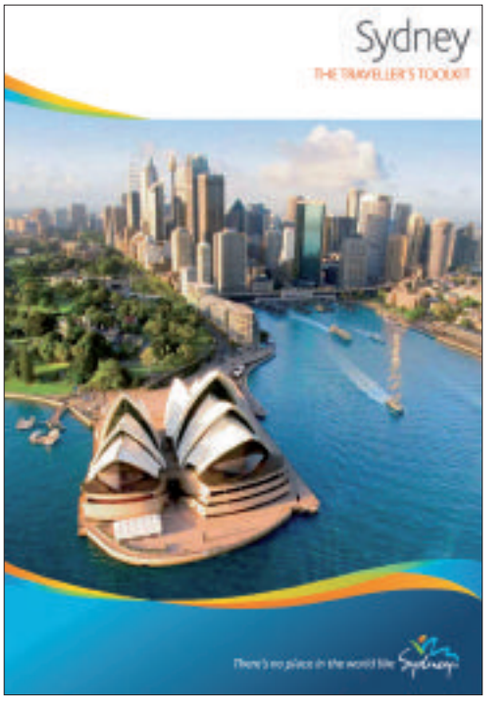

In the late 1950's, the City of Sydney decided it wanted an opera house that would identify that city in the eyes of the world. They wanted an icon. The city conducted a competition to find the right design, and subsequently appointed a little-known architect from Denmark on the basis of what appeared to be just a few hand sketches depicting a sleek, provocative, shell structure. It was a bold leap of faith. The architect's name was Jorn Utzon... and he called on Arup to help transform those sketches into reality. The final product, the Sydney Opera House, caused a great deal of pain during the design and construction period but, in the end, it surpassed all expectations.

During the course of its development, the Opera House went from being a national scandal (as the costs ballooned and the timescales slipped) to becoming a 20th Century icon that sits on a par with the Eiffel Tower and the Taj Mahal in terms of instant recognition. Oddly, it was never recognised as a particularly good opera house but there is no doubt that the building put Sydney on the world map. It gave the city a profile it could not have achieved any other way. What, do you think, has been the business benefit of the Opera House to the City of Sydney over these past 50 years?

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1 Sydney brochure (by permission of Tourism New South Wales)

2 A machinist in Henry Ford's Red River plant in Michigan © Getty Images

3 Raymond Loewy's classic Coke bottle © The Coca-Cola Company

4 Apple iPhone (image courtesy of Apple)

5 (over) The CCTV tower in Beijing

In a slightly earlier era, North America's RKO network invested in a string of new cinemas of modern, art-deco, design all the way across the USA. The chain was an enormous success, and RKO was widely acclaimed as a result. Except in a town in Iowa where, against all expectations, the local RKO cinema was a complete flop. Despite vigorous house-management efforts, the Iowa locals doggedly walked past the attractive red carpet on the steps of the RKO building and made their way to the rather down-market competition further along the street.

It took some while before a design consultant finally understood what was happening. The local farming community was not prepared to walk on the new red carpet in their dirty work boots. The carpet was duly replaced with a rubber mat, and the locals flocked to the new cinema. A case of a small, but important, design insight which unlocked the far bigger potential of the new cinema.

Even earlier, in the early decades of the 20th Century, Henry Ford pressed his architect to put skylights in the roof of his new River Rouge plant in Detroit so that the workforce could enjoy a decent working environment on his newly invented production line. Whether this was a benevolent act, or simply a search for greater productivity, is not clear. But the effect of this design intervention was to enable production outputs to be achieved that were previously unheard of, whilst enabling the Ford enterprise to boast that it was a good and conscientious employer.

All of these examples illustrate the role that good design can play in the development of good business. The creative input of talented designers enabled activities in such diverse spheres as municipal government; entertainment; and manufacturing to be enhanced enormously, with consequent benefit to all.

> The Sydney Opera House gave the city a profile it could not have achieved any other way.

If it is successful, good design can create value far in excess of the quantitative, process-oriented, business improvement disciplines taught at business schools, good though those processes are. We need look no further than today's iPhone for further evidence of that claim. But, unlike those conventional business improvement processes, good design is not easily amenable to *a priori* quantitative analysis. There may be calculations that can be done to estimate the benefits of a cost-cutting programme; a supply-chain re-design; or a transfer of operations. But how do you estimate the value of the Opera House or Raymond Loewy's Coca-Cola bottle, even with the benefit of hindsight? Without a quantitative appraisal, there always has to be a leap of faith at the beginning of the road to good design.

So, what is good design? It isn't always to do with aesthetics, indeed, sometimes it is the opposite, as evidenced by RKO's rubber mat. And it isn't always delivered by a designer name (who remembers the name of Henry Ford's architect?). But it always springs from a fundamental appreciation of the purpose of a product (or service), and an allied ability to create original ideas that significantly enhance the performance of that offering.

Original thought is an indispensable hallmark of good design. Rule-based business improvement processes, by their nature, can be replicated at will, but the creative instinct that produces great design always has a uniqueness and freshness about it. That is why great design confers real business advantage and that is what makes good design so valuable in business terms, despite the lack of quantitative assessment tools which can be applied to it.

(continues)

The advent and significance of performance-based engineering design

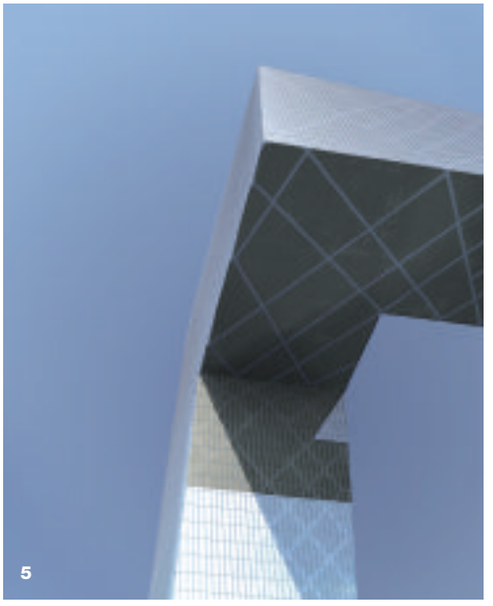
In the past, conceptual design has existed in the provinces of intuition and art, whilst engineering design has existed in the provinces of strict methodology and the application of rule-based criteria. With a few notable exceptions (Utzon and Arup, for example) there has always been a divide between these two essential elements of the design process.

Today, however, all that is changing. Computers and simulation technology have begun to free the engineer from the slavery of rules, and open the door to a much more creative relationship with the conceptual designers. Performance-based design is a term that has been coined recently to describe an approach to design that stands apart from the rule-based methods that have traditionally dominated the world of engineering design. The difference between this, and the old rule-based approach is enormous.

In rule-based design, the designer is required to follow an accepted set of rules that is deliberately constructed in a cautious manner to ensure that a margin of safety exists to protect against uncertainty and the unknown. Such methods sometimes preclude design deviations beyond specified limits and, because of this, they sometimes represent a severe constraint on what can be achieved. 'You can't do that' is the unwelcome result.

In the performance-based approach, the 'rules' are set aside, and the designer sets out to predict how the real product behaves from first principles. The ability to do this has only been conferred in recent times by the arrival of enormous, and readily available, computing power. But the consequence of this is that the engineering designer is now released from the application of rules, and is freed to explore all sorts of previously prohibited technical solutions. Original thought has been allowed to enter the process and, by the definition suggested above, an opportunity to create enhanced value has been presented. Does this open the way to better overall design and consequently to significant market advantage?

There is plenty of evidence to suggest this is the case. At Arup, we have designed increasing numbers of buildings that would have been uneconomic (or impossible) if we had used rule-based design methods. The



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spectacular CCTV tower in Beijing (above) is just one example. This new technique is also able to address areas of design that are relatively new. For example, exploring how buildings behave under extreme loads is increasingly a requirement in this modern world. The response of façades to impacts and blasts; the collapse of structures following severe fires; the shock-response of floors supporting sensitive equipment – all of these things can now be predicted from first principles with a high degree of confidence. Consequently buildings can be constructed more economically, and their envelope of allowable use can be extended. The result is better client value, unlocked by the informed judgements of good designers.

But the potential for performance-based design goes well beyond conventional engineering needs. Historically, engineering design has been limited to the principal technical disciplines of structural, mechanical and electrical technology. Today, we also use very advanced simulation techniques to help us understand and resolve problems which involve the coupling of these disciplines with human perception and response. Examples are acoustics, lighting, crowd movement, emergency evacuations and security.

> At the time of his appointment, Ove Arup had a well-earned reputation as a man able to engineer buildings that others couldn't... and give form to creative, new design solutions.

Further examples of this type of coupled design problem lie in the developing area of 'workplace performance'. We live in what might be increasingly described as the beginnings of the 'Ecological Age'. Understanding and predicting the distribution of air movements, temperatures and humidity levels within and around the complex shapes defined by our buildings is vital if we are to design systems that simultaneously minimise our environmental footprint and maximise human comfort and productivity. This type of simulation demands an understanding of that most complex interaction between the worlds of physics and human perception. What, for example, defines 'comfort', and what type of environmental conditions foster greater productivity in an office or industrial context? Our historic, rule-based, methods could never come close to providing effective answers to questions such as these. But the use of performance-based simulation techniques now opens the door to exploring all sorts of new and creative design solutions and sets the scene for talented designers to create opportunities for real business improvement.

But, in a business-oriented world, how can you seek abstract attributes like 'talent' and prove their value in a risk register or consultant evaluation exercise?

This question, interestingly, brings us back to where we started. The City of Sydney sought an icon which would be instantly recognisable. There was no prescriptive formula which could be applied. There was, simply, a leap of faith. They retained the creative genius of the little-known Utzon who, in turn, leaned on the creative genius of Ove Arup. The result is with us today.

At the time of his appointment, Arup had a well-earned reputation for being a man able to engineer buildings that others couldn't. His work was characterised by an ability to think originally and give form to creative, new, design solutions. The development of performance-based design methods now helps us to ensure that original thought, and creative design, continue to be seen as defining characteristics of our firm. The articles which follow in this edition of A² illustrate this point.

Through the continuing exercise of our design abilities, we intend to ensure that our clients continue to get results that confer real market advantage in this competitive, ecological age.

News

SNOW AND CLIMATE CHANGE
Delivering a low-carbon UK

Over 500 business leaders gathered at Arup's One Big Day event in London on 11 December 2007, to discuss how government, business, technology and society can work together to deliver a low-carbon UK by 2050.

Jon Snow, the award-winning journalist and broadcaster chaired the event and praised the firm for its vision in moving the climate change debate beyond the 'why' and to the 'how'. Guests received high-quality presentations from HSBC, Arup, the Greater London Authority, WWF, The Climate Group, and New Scientist magazine. They also participated in open workshops facilitated by the Cambridge Programme for Industry and engaged in a lively 'question-time' session.

A full report on evidence captured from interactive questions throughout the day is published in a special supplement with this issue of A^2. Findings will also inform a white paper to be prepared later this year. Additionally, an online forum will be launched by Arup from 1 February 2008, in partnership with New Scientist magazine.

www.newscientist.com

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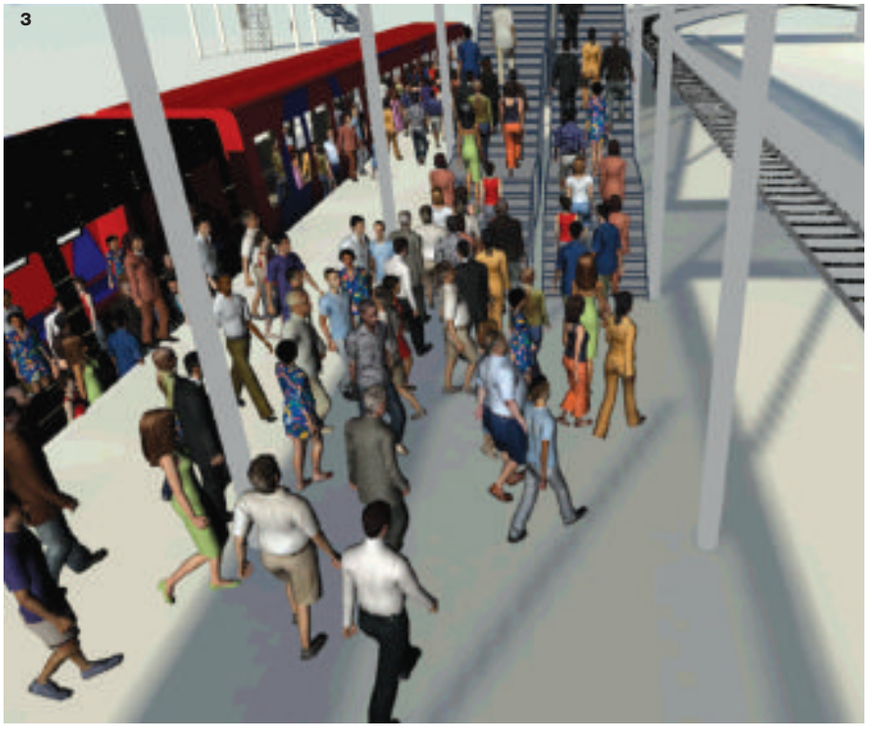
1 John Snow chairs One Big Day
Photo: Hamish Boyle

2 Interactive voting on key themes took place
Photo: Hamish Boyle

3 Arup's 4-D integrated modelling incorporating transport, architecture and pedestrians



PICTURE THIS
Advanced planning design

Arup is pioneering the integration of pedestrian and transport simulations with high-quality architectural rendering software. Combining the software can deliver advanced visualisations of design performance.

Arup planners who commonly use micro-simulation software packages, Legion and Vissim, have been working with the designers of our 4-D Realtime software to add a fourth dimension to their models. The extra dimension means that for the first time, clients can visualise how a space will look and perform with accurate pedestrian and vehicle movements included.

For business leaders, stakeholders and public consultations, the communication benefits are immediate. Seeing a design in operation makes it easier to appreciate its innovation and detail, as well as demystifying technical complexity.

The potential of combined 4-D modelling in urban planning has already been harnessed by the team working on the redevelopment of King's Cross. It is also being researched for future use in Dongtan eco-city in China.

SIGNS OF THE TIMES

Future of airport design

Streamlined signage and an accompanying design manual are being developed by Arup to improve the passenger experience for Dublin Airport in Ireland.

Like many international transport operators, Dublin Airport Authority (DAA) has been affected by rising passenger numbers, retail growth, and slower check-in times because of heightened security. Extra signage and reduced mobility are immediate consequences of expansion and Arup was hired as part of a project team to make wayfinding easier.

By aiming to provide passengers with the right information, at the right time, Arup has updated DAA's signage, reducing it by 30%. On-site trialling of new signage and user group testing of the accompanying design manual has indicated significant improvements.

"The business benefits of better design are clear", says Arup Consultant Jo McKiernan: "Good wayfinding can encourage passengers to turn up to the gate on time, spend money in shops, and use the airport again."

Similar results have also been delivered by Arup for Hong Kong International Airport.

SUSTAINABILITY POLICY SHAPES STRATEGY

A sustainable approach to business

A team of Arup's business leaders has formalised the sustainability policy that shapes the firm's global strategy.

The policy supports a process of continuous improvement and integrates Arup's core sustainable values across its business, people, facilities and external relationships. This central framework and sustainable knowledge toolbox can be easily referred to by Arup businesses on behalf of their clients. It is also driving the development of region and sector-specific sustainability strategies that are being rolled out across the firm's global operations.

Arup Group Sustainability Director, David Singleton says: "At Arup, we believe there is an overwhelming case for taking a sustainable approach to business; it is an intrinsic part of any project solution."

With this policy in place, Arup is working to pursue, promote and develop sustainable business outcomes, both for clients and in-house.

www.arup.com/arup/policies.cfm

1 Detail from Arup's new signage manual for Dublin airport

2 The Panasonic World Solar Challenge 2007 covered 3 000km of challenging Australian road © World Solar Challenge

3 Graham Sparey-Taylor and team with their Solar vehicle Gwawr ('Dawn')

4 Gwawr on the road

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DRIVING IN THE SUNSHINE

Solar car wins award

A solar powered car sponsored by Arup, has won an environmental awareness award at the Panasonic World Solar Challenge in Australia.

The vehicle, built by a Welsh team for just £8 000 and led by lecturer Graham Sparey-Taylor, competed in the 3 000km race from Darwin to Adelaide on 21–28 October 2007. Its impressive performance capability is highly significant says Arup's Head of Vehicle Development, Neil Ridley: "We supported this entry because it used off-the-shelf components and technologies to demonstrate what can already be achieved with sustainable transport."

Arup is currently leading the development of sustainable transport solutions by assessing the energy and carbon usage involved in vehicle manufacture, use and recycling. Ridley continues: "This 'dust-to-dust' approach provides the most thorough method of comparing new designs and selecting those least damaging to the environment."

It is anticipated that this type of whole lifecycle vehicle testing will soon become commonplace and could be part of the legislative or taxation regime in the future.

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TREADING LIGHTLY

First footfall analysis white paper published

Experts at Arup's software house, Oasys, have authored its first white paper on footfall vibration and finite element analysis. The development follows the launch of a new version of Oasys's popular GSA structural design and analysis software, which now incorporates footfall analysis.

Version 8.2 of the software is particularly useful for clients with sensitive vibration requirements such as hospitals, laboratories and airports. The accompanying white paper offers a reference guide to the software's capabilities, and also gives an overview of the vibration problem, market drivers and how to measure footfall.

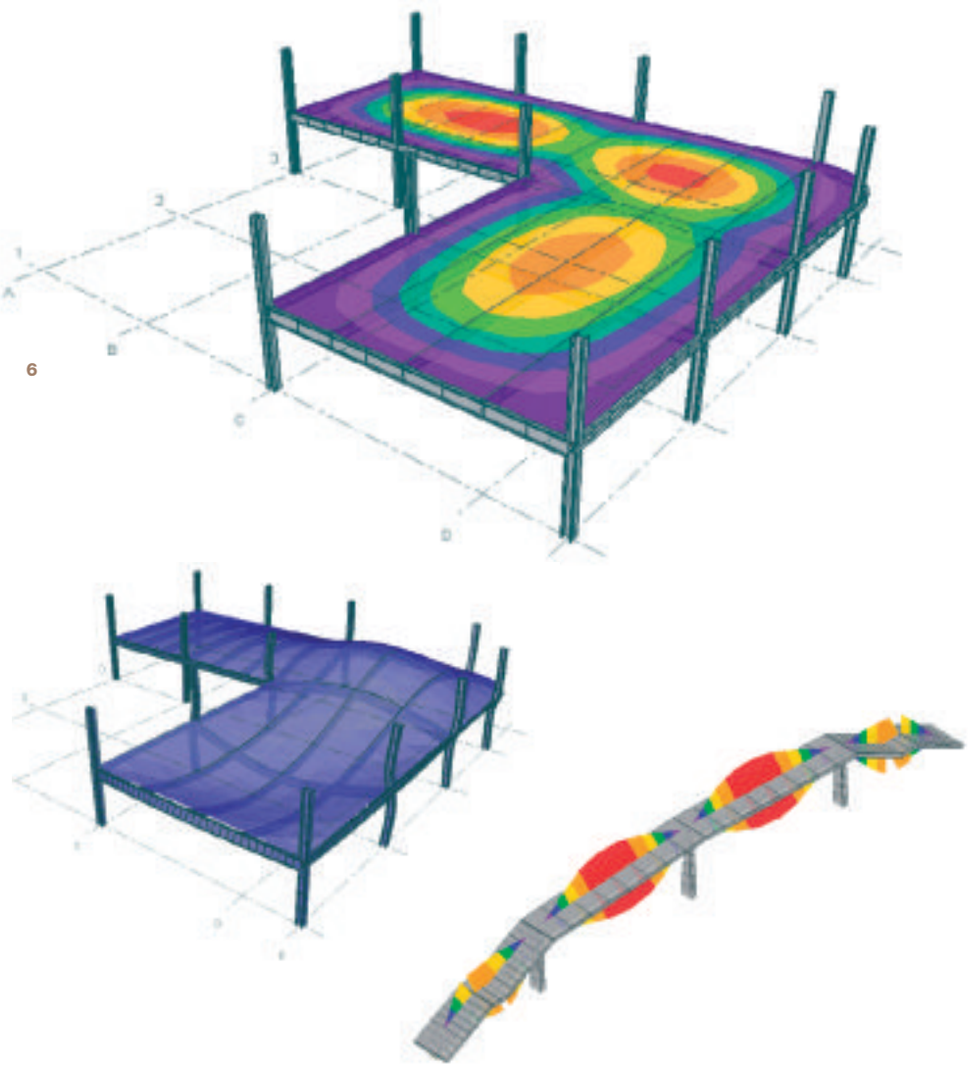
Among the benefits highlighted by the white paper is GSA 8.2's ability to predict absolute vibration levels at all locations on a floor. Crucially, this enables consultants to position sensitive equipment and services, or to improve problem areas in a cost effective way.

Arup's methodology was developed by the Advanced Technology and Research Group and has been used extensively within Arup for the past five years. This methodology has been adopted by the Concrete Centre, who published an Arup authored 'Design Guide for Footfall Induced Vibration of Structures', in 2006. It also forms the basis of the new Design Guide published by the Steel Construction Institute in 2007.

www.oasys-software.com

5 Al Gore with Cathy Crawley (Sustainability Business Unit Leader) at the launch of the Financial and Energy Exchange in Sydney

6 GSA vibration and footfall response results on building and bridge structures



EXCHANGE OF IDEAS

Carbon trading boost

Al Gore, former US Vice President and Nobel Peace Prize winner, was guest speaker at the recent launch of Sydney-based Financial and Energy Exchange (FEX) – a platform for the trade of carbon and environmental commodities and derivatives.

Arup is part of the FEX Advisory Group, and has developed the FEX Climate Voluntary Emissions Reduction Protocol. This prepares FEX member businesses for future carbon opportunities and constraints by measuring, reducing and offsetting their emissions.

FEX combines a national carbon registry, a sustainable investment market, and a carbon and environment exchange that pre-dates the emerging mandatory Australian scheme by a number of years. These structures are underpinned by FEX Climate which facilitates carbon market demand and supply by directing investment towards climate conscious businesses, technologies, and product and service providers.

Arup is pleased to be involved in the development of the FEX business model, as it presents a tangible, commercial way for business to make the transition to a low-carbon future.

www.fexclimate.com

STRONG MEDICINE

Healthcare productivity reforms

The second independent review of NHS spending, written by Sir Derek Wanless, was published recently, revealing significant room for improvement in how and where money has been spent over the last five years.

The review, *Our Future Health Secured?* was written in September 2007 for the Kings Fund – an independent charitable foundation working for better health. It reveals that, since 2002, there has been little evidence of improvements in productivity. This is despite an average real terms increase in yearly healthcare spending of over 7.5%, and the increase in numbers of doctors and nurses exceeding all targets.

To support productivity improvement, Arup has been working with the NHS to manage the potentially conflicting challenges of improving patient care, cutting waiting times, enhancing facilities, reducing costs and boosting staff morale. Using lean techniques in partnership with clients, we are assisting them to improve pathway and process performance, freeing up time to add value to the patients and improving job satisfaction.

www.kingsfund.org.uk/publications

USER-CENTRED DESIGN AND ITS VALUE TO BUSINESS

A poorly designed workspace can have a real impact on productivity and business performance. Dave Evans examines Arup's research into balancing the needs of people with systems to achieve truly user-centred design.

The way people work is changing and more of us are using our homes as offices, or 'hot-desks' within the business environment. Providing the right infrastructure to measure and cater for this change is essential to creating an environment that inspires creativity and collaboration in individuals and teams. The workplace has an enormous effect on the psychological wellbeing of the people in it and this should be factored into the design mix from the start. Arup business consultant Dave Evans, specialises in business change, organisational behaviour and organisational development and says: "Early research into the client's visions, values and desired outcomes including user needs, ensures that the right environment is created first time, saving effort and money that might otherwise be spent on redesign and retrofit later."

For architects and engineers, designing to accommodate the different physical attributes, emotional needs, intellectual abilities and workload demands of individuals is challenging. It takes the design and planning process far beyond its usual boundaries and requires input from experts that are not normally included in building design programmes. "At Arup we use a range of methodologies to engage architects and engineers in design work that brings users into the process – from an individual, group or societal perspective", says Evans. "Gaining a comprehensive understanding of people's interactions within an organisation's daily operations and analysing working styles can really help to define and achieve the desired organisational vision."

VITAL STATISTICS

Poor working environments could be costing British businesses more than £135bn every year[1]

Six out of 10 office workers believe their workplace has not been designed to support their company's objectives, or their own job function[2]

An employee's workplace is representative of 24% of his/her job satisfaction[3]

Good design can reduce absenteeism by 15% and increase productivity by 20%[4]

1 'These Four Walls, The Real British Office', Gensler , Design & Planning Worldwide, 2005

2 HSBC research, cited in 'Management Issues' magazine 18 July 2005

3 & 4 'The Impact of Office Design on Business Performance', Commission for Architecture & the Built Environment and the British Council for Offices, cited in Management, Issue 23, May 2005

Once extensive user-centred research has been done, practical solutions can be designed and applied. This can bring numerous benefits – helping teams to form and be more effective in their performance, supporting organisations through significant change, and planning and delivering maximum outcomes.

Recently conducted reviews of psychological literature have helped Arup to understand the science of workplace design and behaviour. Findings have also revealed that ineffective design has a host of counter-effects. For instance, while open workspaces can improve communication, they can also create a potentially negative effect on interpersonal relations and job satisfaction by encouraging the onset of intra-group conflict. 'Hot-desks' also emerged as a prominent driver of workplace dissatisfaction, as they cause an undesirable reduction in individual workplace identity if they are poorly introduced or designed.

Having an intimate understanding of everything about an organisation, from its mission and structure to customer and stakeholder relationships, can give vital insight into performance-enhancing design. Despite this, ensuring that an organisation's facilities reflect its persona and culture is still very much an afterthought for many, admits Evans. "When a decision is made to redesign an existing workplace, or commission a new facility, the key challenge for us is to raise the profile of user-centred input on the project management agenda." Projects like those at the Merseycare NHS Trust and King's Cross station have been defined by early engagement with stakeholders and staff. In these cases, Arup has achieved a final design output that is most closely aligned with organisational aims, objectives and working practices.

Ideally the design approach should be multi-layered. In the first instance, engineers are focussed on the built environment and application of the most appropriate technology. Secondly, operations people concentrate on developing processes that enable the design to be exploited effectively. Finally, deployment of socio-technical approaches can be used to combine people, process and technology within the prevailing environment. This three-pronged approach unites the design team and is applicable to any project – from an Olympic Park, to a building, station, or office." Any change in workplace design, whether through refurbishment or commissioning of a new facility, is effectively an organisational change programme as well as a facilities management project", Evans points out. "Creating a programme to manage new design transitions can help to enhance employee morale, corporate culture, operating procedures and processes, and organisational structure."

While effective design may be difficult to measure in financial terms, it is clear that the full-term operating costs associated with populating and running an organisation or a building are likely to far exceed the capital outlay of the facility. Ensuring a building is designed to optimise the effectiveness of individuals and teams that will be working within it seems like an obvious and financially sensible investment. "As organisations, designers and individuals, we must continue to look critically at our workplaces and what we do in them", concludes Evans. By considering the human impact of a new building and examining how it performs once people are using it, we can get closer to striking a true balance between people, systems and technology in every design.

Design for Human Performance: Research Excellence Through Collaboration

CAMBRIDGE, DECEMBER 2007

This Arup Research Network Forum fostered collaborative opportunities with academia and industrial partners around the theme of Design for Human Performance. It was organised in collaboration with Leeds University, with guests including representatives from networking organisations, design universities, manufacturing, automotive and telecommunications industries.

Invited guest speakers gave presentations on the needs and challenges facing businesses in the area of design for human performance. These were followed by lively discussion on issues such as design for stakeholder benefit, inspirational workplaces and social sustainability.

The event concluded with all delegates proposing future topics for further collaborative research around this theme. These topics were summarised into three that will be developed and shared with research councils and potential research partners:

1. Design of the workplace for new work styles
2. Green agenda and human behaviour
3. Building design and corporate productivity

USER-CENTRED DESIGNS IN PRACTICE

Ian Rowe, Head of Human Factor Integration, explains: "People are more likely to accompany an organisation on its journey through change if they feel engaged and involved in influencing that change. Arup has helped clients achieve superior performance across sectors including healthcare, transport and media, by involving the people who will use the finished product in the design process."

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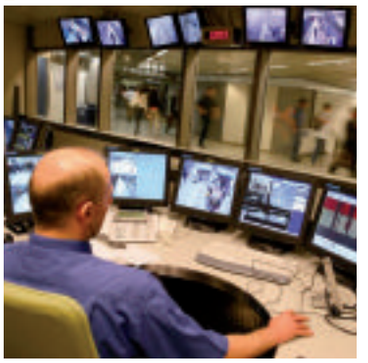

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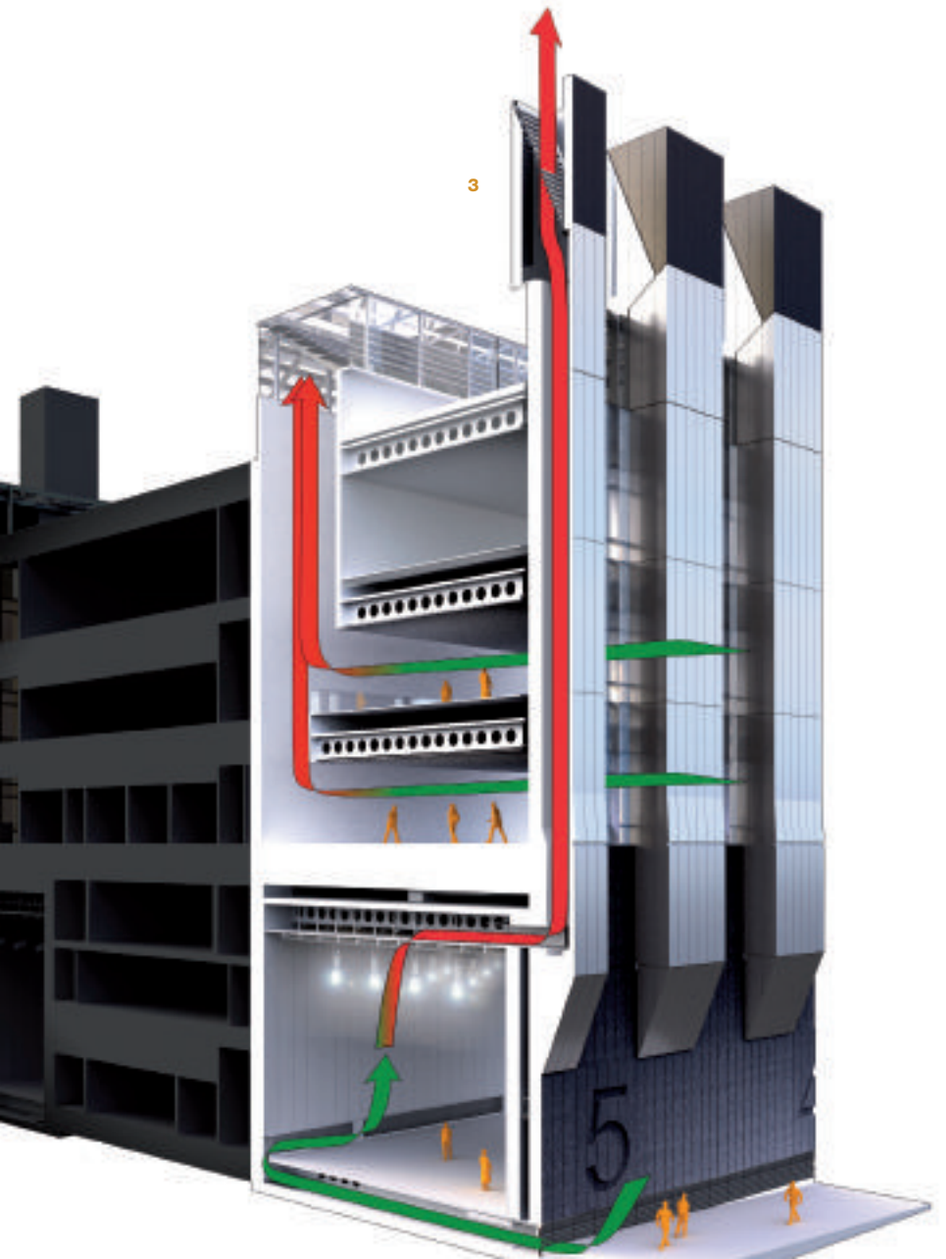

HEALTHCARE

Merseycare NHS Trust, Liverpool, UK

Arup was commissioned to develop plans for a number of new healthcare facilities for Merseycare NHS trust in 2007. Our organisational consultants and occupational psychologists deployed some simple behavioural tools to understand how the building design could be maximised from a staff morale perspective. Staff from five different hospital sites (1) were sampled using a range of techniques including observation, unstructured interviews and focus groups. The effects of temperature, ventilation, space, safety and working processes were factored into the study. Arup business consultant, Dave Evans explains: "Viewing physical environments as operational tools that can influence how people work enabled us to go beyond the surface to gain deep perceptions of each facility as a workplace." The team found that the basic design approach could significantly contribute to improved performance and an organisational culture that is more conducive to staff and patient wellbeing.

PUBLIC TRANSPORT

King's Cross St Pancras Underground, Euston and Canary Wharf stations

When designing a new control room for King's Cross St Pancras Underground Station in London (2), Arup consultants worked alongside the people who would be operating the controls to reach the most effective solution. By consulting end-users about the best layout for the equipment that they would sit at every day, we were able to find a solution that would deliver optimum performance. Consulting users from the start of the design process also helped to make them feel part of the change and ensure that the performance benefits were sustainable. Making people feel like part of the process allowed them to carry the changes forward, work more effectively and efficiently, and ultimately deliver better business performance.

Solutions for other public transport providers include helping Network Rail to re-align its team goals before taking over from Railtrack. Arup has also conducted crowd studies at Euston Station and Canary Wharf, to enable evacuation plans to be designed around how people actually behave in an emergency.

GLOBAL MEDIA OPERATOR

BSkyB

Some organisations recognise 'design for human performance' as essential to their business strategy. As global broadcaster BSkyB want to inspire their staff with a new decentralised UK campus in Osterley, West London (3), Arup are working with stakeholders at every level to ensure that people's work and personal requirements are being met. Studio and office buildings are being consolidated by the site's campus-style framework which is being defined by a central, covered pedestrian corridor known as 'the spine'. The spine provides covered pedestrian movement and access, landscaped areas in which staff can work and socialise, outdoor places for broadcast and a large area for entertaining. This flexible and integrated design concept recognises from the outset, that good design is essential to enabling optimum human and business performance at BSkyB.

A LIGHT TOUCH

Rogier van der Heide profiled for A²

Name:
Rogier van der Heide IALD (International Association of Lighting Designers)

Position:
Global Leader of Arup Lighting and Consulting Sector in the Netherlands

Biggest challenge:
Converging design and technology to create unique, holistic solutions

Most innovative work:
Louis Vuitton's award-winning worldwide lighting concept

Future aspirations:
"Influencing Arup's design and technology business to act as a more holistic team, regardless of the disciplines involved."

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1 Rogier van der Heide

2 Galleria West, Seoul

3 Louis Vuitton, Madrid

4 Louis Vuitton, Hong Kong

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Since joining Arup in the Netherlands in 2003, Rogier van der Heide has become a major creative force in the global lighting design and consulting sector business. As a leader of innovative, creative and well-executed projects all over the world, Van der Heide's approach is focused on bringing Arup's design and technology businesses together:

"I like to show clients how we can deliver a true value proposition by developing and implementing better design, regardless of the disciplines involved", explains Van der Heide. "Clients are showing an increasing desire to converge design and technology into solutions that drive their businesses. For us, this means bringing together experts from all over Arup to work holistically and gain a thorough understanding of the client's business."

This level of integration only works when clients take part and collaborate with designers. To make this happen, Van der Heide and his team ensure that every client has a thorough understanding of the value of light and media: "Across the world, we have lighting design teams that are diverse groups of individuals. This enables us to develop multi-dimensional views on projects, and combine artistic flair with sound technical excellence."

Arup's designers are trained to think beyond lighting. While every project has some level of innovation, Van der Heide believes that the best examples use existing, proven technology in a 'new, different and unexpected way'. A high profile example of this is Louis Vuitton's worldwide lighting concept. Design was led by Van der Heide and centered on a 'smart and well integrated concept' that 'fused materials, light and architecture together into a single environment creating a total experience'. The approach was recognised in 2006 with the Madrid LV store winning an International Association of Lighting Designers Award of Excellence. Rogier had already received the coveted IALD Radiance Award in the previous year for his work on Galleria West in Seoul.

Creating a 'total experience' with lighting can improve a business's productivity by making people feel happier and more inspired at work. But calculating commercial value is different for every client says Van der Heide: "The best design does not just improve functionality or sustainability, but adds intrinsically to the client's processes or business, at a very fundamental level. A holistic approach that brings together the full spectrum of Arup's design and technical capabilities can elevate a solution from function-driven, to business-driven design."

THE INCOMPLETE CITY

Designing cities for long-term sustainable performance is the natural thing to do, argues Malcolm Smith, Arup Director of Urban Design.

Resource depletion and climate change are affecting the way we think about urban design. If we are to achieve sustainable performance – environmentally, socially, and economically – from our cities in an uncertain future, we must design urban environments that can respond rapidly to change. This means thinking not just about the specifics of climate change but considering how design can improve the ways people interact with their environment – the city as an eco-system.

It's an idea that's essential for the future, and one that's relevant and marketable today. Businesses embracing this idea are already reaping the rewards. For example, developers are increasingly recognising the corporate value of civic space. People with access to open space are happier and more productive. So by creating public realm alongside private residential or commercial space, developers are able to add value both to their buildings and the people who live or work in them. The space taken by adding a park, for example, is offset by the increased population density in modern buildings resulting from factors such as hot-desking in offices.

In the UK, developments such as Stuart Lipton's Broadgate Arena show understanding of the value public realm has to offer corporations and people alike. The Stratford City masterplan embraces seven new pieces of public realm, including a series of water cascades and North Park, an urban space which can hold 10 000 people. And in Northstowe, a new town being designed for the north west of Cambridge, 80–90% of the 25 000 population will be within 200m of open space, able to walk there in five minutes.

UK Government agencies are beginning to insist that social infrastructure linking people to each other and the environment is embedded in developments. With this infrastructure in place, cities can self-negotiate and respond rapidly to future change. Think about London after the Great Fire in 1666: people were re-building their houses and businesses around the existing infrastructure before Wren could put his grand design for the city into action. We can harness this natural idea to develop sustainable cities that can respond quickly to change.

To see the performance benefits of this approach you have to look no further than the efficiency of a beehive. By designing our cities according to dynamic performance criteria – the same kind of process through which nature designs a beehive – they will have a dynamic, rather than absolute, relationship with the environment around them. For example, when you're designing a building, you consider its impact on air quality, but you don't consider that in isolation. You also look at its relationship with acoustics, wind speed and a host of other factors. This kind of bio-mimicry is a complex way of understanding cities' relationship with the environment around them. To achieve it, we'd do well to pay attention to the lessons nature has to teach us.

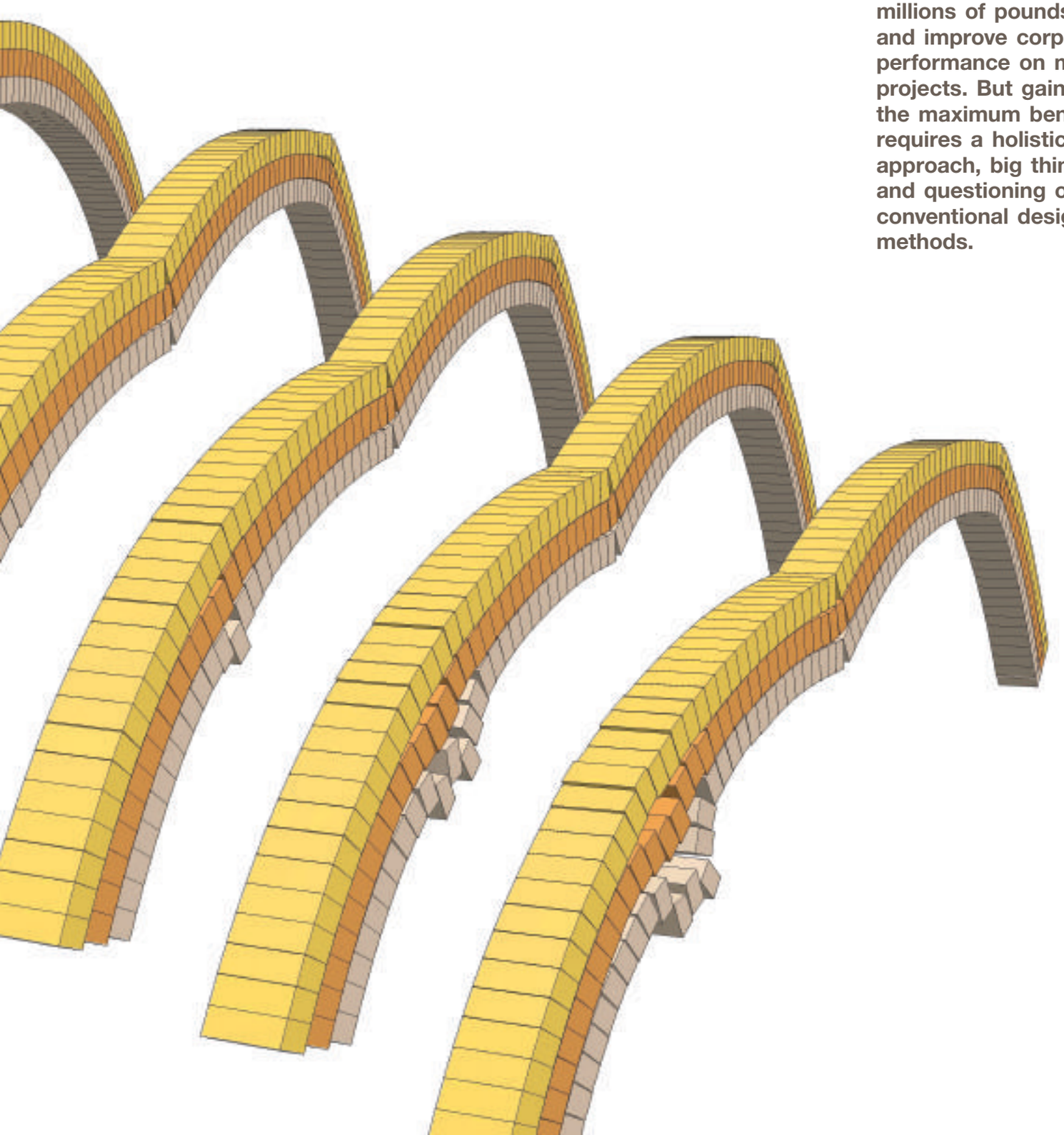
Mimicking the performance of eco-systems in urban design requires decentralised networks – energy, water, social, and financial. The recent flooding in the UK has shown the vulnerability of centralised systems to events which may occur more frequently as a result of climate change. Why design a system where hundreds of thousands of people rely on one power station and are vulnerable if it should fail? Creating such a network would increase resilience and reduce risk.

Delivering infrastructure – power, waste, water and sewerage – locally would unlock the market and enable local communities to take part in the delivery of their services. This would localise flows of money, people and intellect, and increase social accountability. If the person who provided your power lived next door, you'd have a social as well as a financial connection.

Re-localising cities through integrated urbanism challenges the notion that city-making is the realm of the heroic individual. This is no longer the case. It's now the realm of negotiated interface – careful attention to the way all the different elements work together. Individual visions of urban futures date before the concrete is poured but by understanding the inter-relationships at work, we can create cities designed to perform in an ecological age.

COST SAVINGS BY DESIGN FROM ADVANCED TECHNOLOGY

Mike Willford explains how innovative designs can save millions of pounds and improve corporate performance on many projects. But gaining the maximum benefit requires a holistic approach, big thinking and questioning of conventional design methods.



Using performance-based design and sophisticated numerical simulation technology, Arup's Advanced Technology and Research Group has realised major cost savings in the real world by exploiting innovative ideas.

Controlling wind sway

A novel approach to controlling the sway of tall buildings in the wind saved in excess of $5M in construction costs on a 60-storey residential building in Manila. The original scheme required large tuned liquid dampers which took up valuable space at the top of the building. The alternative, patented by Arup, is a damped outrigger system incorporating viscous dampers connecting reinforced concrete outriggers from the central core to the perimeter columns. It permits reductions in structural element sizes, cuts construction costs, and increases income potential with extra floor area.

Designing lighter roofs

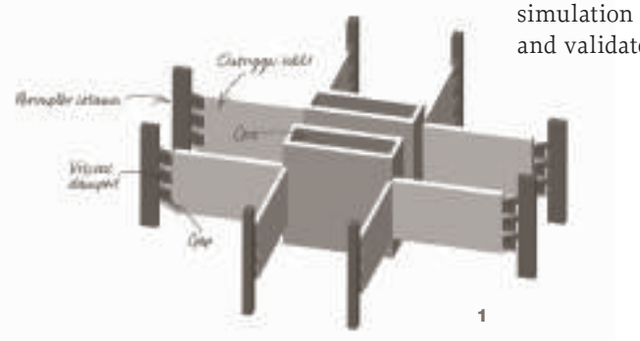
A new method of processing wind tunnel test measurements is leading to significant cost savings for long span roofs. Time-histories of pressure distribution over the surfaces of a roof are measured in wind tunnel model tests, and conventionally a roof is designed to resist the peak pressures applied in distributions selected by the engineer to allow for various spatial pressure variations and factored for dynamic amplification. The distributions are necessarily conservative since the process is inexact. In the new method, the many measured pressure time-histories are applied directly to a dynamic model of the structure, involving a computationally intensive analysis, providing much more reliable and accurate wind response predictions than the conventional approach. This enables the weight and cost of stadium and other long-span roofs to be minimised. The technique has been adopted for several major roofs now completed.

Innovative seismic design

A highly unconventional concept helped save $1M in construction costs on Maison Hermès in Tokyo – architect Renzo Piano's slender, transparent glass building. Arup designed a structure which allowed columns to lift slightly at their bases in major earthquakes. Numerical simulation showed better performance in the strongest earthquakes than a conventional structure using three times the quantity of steel.

A similar idea saved almost $2M on another prestigious project in highly seismic San Francisco. Instead of the conventional use of ground anchors to tie foundations down, we demonstrated by advanced simulation that the modest degree of uplift on unanchored foundations was acceptable – and the cost of anchors unnecessary.

This kind of holistic performance-based seismic design – considering the structure and foundation together – can often demonstrate that a simple design will perform better than a more expensive, conventionally designed solution. This was the case with a liquefied natural gas (LNG) facility on very soft ground in Trinidad. Conventional design required ground improvement and seismic isolators to achieve a viable design for the 70m diameter, 120 000 tonne tanks. Simulation proved however, that if the weight of the tanks was supported on an economic steel piled foundation, ground improvement was unnecessary. Existing soft soil would naturally provide 'free' lateral seismic isolation.



1

Sustainable vehicle design

How do you reduce CO_2 emissions from a vehicle? One way is to reduce its weight, cutting the amount of fuel needed to drive it along. That's exactly what our vehicle design engineers did with the SuperLIGHT-CAR, a collaborative project co-funded by the European Commission.

Working in partnership with several European car makers (Volkswagen, Fiat, Opel, Renault, Volvo, and DaimlerChrysler) we helped bring lightweight automotive technologies closer to reality for high volume car production. If the project's ambitions to allow a 30% weight reduction in C-class car models of the future are fulfilled, it will save millions of tons of fuel and carbon dioxide emissions.

2

Assessment of existing structures

Advanced simulation can reduce the need for expensive refurbishment work. Consultants had originally assessed a multi-span masonry arch bridge carrying a trunk road in the UK as requiring expensive strengthening work. Arup were able to prove that the bridge had adequate capacity, without strengthening, by using an advanced simulation methodology that we developed and validated with full scale testing.

Opposite Numerical simulation of masonry arches
1 Arup Damped Outrigger System
2 The SuperLIGHT-CAR in development

Green design

From new cities to green roofs, landscape and ecology can improve performance as part of an integrated design solution. By considering them from the very beginning of a project, we can create sustainable environments which are beneficial for communities and business.

Green space is well-known to be desirable; proximity to it increases property prices. In Dongtan eco-city, China, ecology and layout strongly dictated the urban layout. Wildlife corridors were created to connect people to nature and these linear parks mean that everyone is within three minutes' walk of open space. This strategy increased the value of property without increasing the cost of construction, improving the city's financial performance. It also provided wildlife corridors, increasing ecological performance, and the landscape design work has won a 2007 Landscape Institute Award.

Arup's work on a 150 hectare new town, in Shangdong province, China, integrated development needs with the site's history and natural environment. With the area struggling to keep up with water demand, we suggested turning drainage culverts into terraced parks in order to capture rainwater and build soil. The terraces use natural resources to maintain themselves, give people access to open space, increase the value of nearby property, and help retain water for the city's use. The parks also provide safe and extensive cycle and pedestrian links through the city.

For High Speed 1 (formerly known as the Channel Tunnel Rail Link) and as part of the Rail Link Engineering consortium also comprising Bechtel, Halcrow and SYSTRA, Arup conceived and realised the high standards of landscape and ecology design that were essential to the potentially contentious project. The design also provided cost-effective and sustainable solutions. The low-lying route meant that more than 10M cubic metres of soil were left over after construction. Instead of sending it to landfill (which would have been both costly and wasteful), we used a sustainable solution to improve the reference design – providing an integrated route that blended into the landscape, delivered new habitats, and provided noise bunds thus reducing the need to erect special noise fencing.

A key objective for High Speed 1 was to re-establish as quickly as possible the woodland communities of Kent through which the route cut, many of which were of ancient origin. Specialist lifting up of habitats and translocating them wholesale is costly and is not always successful, and although planting trees will establish a canopy layer, it takes a long time for the field and ground layers of typical woodland

Incorporating landscape and ecology considerations into an integrated design has proven performance benefits. It is performance that's truly sustainable in all senses of the word: environmental, social and economic.

plants to develop. We went back to basics to identify the key components and processes on which the communities were based, and designed a straightforward and low-tech solution that would achieve the desired result. The woodland soils, full of fungi and invertebrates and plant progagules would be the key to the success of establishing the full woodland community of oak trees, brambles, bluebells, wood anemones, birds and mammals. Now, eight years on, woodland communities similar to the original are growing on the sites. A low-tech but carefully designed solution is delivering good performance.

Too often mitigation is piecemeal: for example, clumps of trees squeezed around a new business park can become neglected by office workers and not achieve the predicted mitigation value. But landscape and ecology considered as part of the integrated design can improve performance by reducing maintenance and even generating an income stream. The regenerated woodland sites were carefully selected so that they expanded existing woodlands that were being managed successfully – the client wasn't left with odd pockets of land to look after. Additionally, the trees planted included sweet chestnut, which have value to commercial forestry. And because High Speed 1 requires 12m of clear space either side of the tracks to ensure trees don't fall on the line, it creates grass areas which could be a maintenance burden. However, by landscaping 430 hectares with low nutrient subsoil instead of rich topsoil, we were able to limit grass growth and reduce the need for maintenance. This approach also had the benefit of promoting the biodiversity of the grasslands, allowing 14 different communities to be established.

Integrating landscape and ecology into the project process has helped mega-projects like High Speed 1 move through the planning process and be built successfully. But they also have implications for business. We've worked with developer British Land at board level to see how their business decisions engage with biodiversity and help them create a strategy and minimise risk. It's something that shareholders are demanding. So by demonstrating their commitment to encouraging biodiversity, they can potentially increase their share price.

We helped British Land design green roofs that would be appropriate for their business model. Their work includes refurbishing existing buildings and building new ones in London and standard green roof products aren't always right for these situations. By finding a suitable solution, we'll help them meet their own corporate responsibility commitments and those of their stakeholders, such as the Mayor of London's Living Roofs initiative. But because the design will produce a roof which has performance benefits (in areas such as insulation and water retention as well as biodiversity) they'll be able to embed a commitment to biodiversity at the heart of their business and deliver improved performance.

Incorporating landscape and ecology considerations into an integrated design has proven performance benefits. It is performance that is truly sustainable in all senses of the word: environmental, social and economic.

Above Mick Hall (L) and Tom Armour (R)
Main The 'living roof' at California Academy of Sciences

DESIGN FOR ENERGY EFFICIENCY

Arup's Strategic Energy Consultants conducted a major energy audit for a Pfizer. The result was a major improvement to their bottom line.

Arup's comprehensive audit on Pfizer's existing campus of buildings in California led to the identification and implementation of efficiency measures worth over $1M per year in savings plus a reduction of 5 000 tons of CO_2 annually.

Opportunity

To improve corporate sustainability and reduce energy costs, Pfizer looked to Arup to identify and implement energy conservation measures at its California research facility.

Challenge

Covering 38 acres, the 1M sq ft campus of laboratories and offices was only six years old and included a number of LEED® certified buildings. Arup was engaged to evaluate and implement high-value, operational and engineering adjustments to reduce Pfizer's $5.4M annual energy cost. This, in turn, would significantly reduce corporate carbon emissions.

Solution

Arup benchmarked energy consumption, studied building usage patterns and reviewed building systems control and operational sequences. Arup then developed a list of energy conservation measures with associated costs and estimated ROI for each measure. From this list, Pfizer was able to select a suite of Energy Conservation Measures (ECM) to fit within its financial objectives.

Results

Arup identified 42 possible energy reduction projects with a combined average payback of 8.4 years. Of the 42 projects, Arup recommended six projects for immediate implementation. These projects are known as Phase 1. Arup calculated an annual electric and natural gas savings value of $935 000 for the Phase 1 projects and estimated the simple payback at six months. The Phase 1 projects were implemented in 2005 and the results indicate the actual savings to have been approximately $1M annually, representing a 19% reduction in energy costs. These results have been verified by a third party consultant working for the local utility company.

1 Supply air static pressure reduction

The air handling unit static pressure setpoint was found to be set much higher than necessary. By reducing the setpoint, Arup was able to reduce peak and overall electrical energy consumption.

Annual* electricity saving: 569,402 kWh / $62 565

2 Exhaust fan static pressure reduction

Similar to supply, the exhaust fans were set at excessive static pressure setpoints. By reducing the setpoint, Arup was able to reduce peak and overall electrical energy consumption.

Annual* electricity saving: 192,127 kWh / $20 787

3 Reduce space airflow

Airflows to many spaces were found to be in excess of the building occupants' needs and code requirements. Arup found and implemented an average 23% reduction to CFM (cubic feet per minute), while the night-time CFM brought an average 30% reduction.

Annual* electricity saving: 1,744,673 kWh / $321 486
Annual* natural gas saving: 44,694 therms / $36 649

4 Thermostat deadband increase

Field observations and information received from the campus personnel confirmed that the room temperature was set at 72ºF without any deadband. Required by the California Energy Code and where possible for non-critical spaces, heating and cooling set point was re-established with a minimum of 5ºF between the heating and cooling set points.

Annual* electricity saving: 409,608 kWh / $77 046
Annual* natural gas saving: 568 therms / $466

5 Night-time setback of airflow

Many air handling units run 24 hours per day for both lab and office areas. Airflow supplied during night-time hours could be reduced to selected spaces to maintain a wider deadband.

Annual* electricity saving: 4,281,882 kWh / $358 232
Annual* natural gas saving: 82,250 therms / $67445

6 Night-time setback of air handling unit temperatures

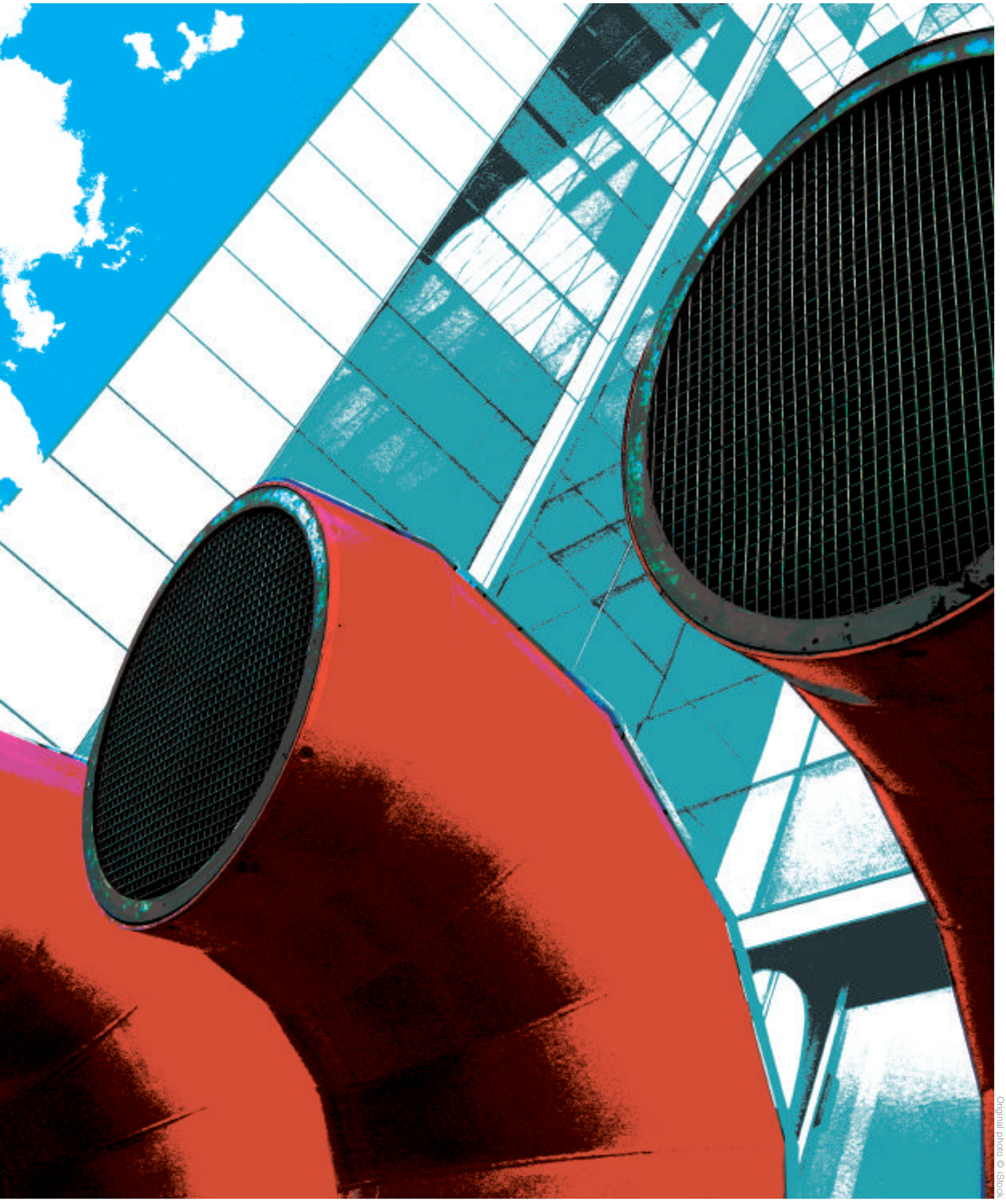
For spaces that do not require critical temperature setpoint requirements, night-time temperature setback was implemented. Allowing the setpoint for zones to drift during unoccupied times resulted in less fan, chiller, cooling tower, boiler and pumping energy being expended unnecessarily.

Annual* electricity saving: 456,581 kWh / $38 199
Annual* natural gas saving: 50,047 therms / $41 038

Total Cost/Benefit

A third party energy consultant certified the $1M annual energy cost savings results for the San Diego Gas & Electric Retro Commissioning programme. As a result of Arup's work with SDG&E the campus received a $67 000 implementation.

Annual* energy savings $1 023 913
Implementation cost $380 500
Simple payback 0.38 years
* Estimated figures



Original photo © iStock

Above 'Enabling Innovation' Workshop, November 2007

Enabling innovations

In an ever demanding working environment, creativity and innovation are often over-looked and neglected as areas for investment in terms of money, resource and time.

'Enabling Innovation', a two-day workshop, was designed and hosted by Arup's Europe Design and Technical Executive, and Director Richard Terry. The intent was to create much needed time and space for internal and external business leaders to review this area. Arup, like many organisations, recognises that innovation, creativity, design and new ways of solving problems can often create a differentiator against the competition and ultimately affect the bottom line. The firm's Design and Technical Executive has been proactive and influential across the organisation in promoting and encouraging the highest standards of design and technical skills.

Both delegates and speakers were invited to tell their own innovation success stories, and share favourite personal innovations with the group. As well as understanding what had been accomplished, the context in which it had been done was also key to the discussions.

One of the aims was to develop and define a common innovation vocabulary for Arup and its guests. It became clear that a move away from an assumption, or expectation of innovation happening by chance was required. From these initial discussions it was important to understand the value of innovation to business performance and change internal behaviours to support its proactive position in an organisation.

The characteristics of innovators were explored. They can often be seen as curious, persistent and determined, but can also be misinterpreted as being disruptive and a nuisance. An innovator may be viewed as one of four characters: the bright spark, the enabler, the champion and the implementer. In order to develop, innovate and create the competitive advantage, how many of these are visible and nurtured within organisations today and how much collaboration supports them?

Lucy Hooberman, Innovation Executive at the BBC, talked about the preconditions that need to exist in an organisation in order to embrace 'open innovation.' Opening up of internal communications including enabling staff to have internal blogs and project wikis predated the move to releasing BBC content feeds via RSS and APIs. via BBC Backstage. This enables the external developer communitiy to mix and mash-up BBC feeds with others to make new ideas and prototypes

"Ideas cannot be owned by anyone: they are not possessions." Ove Arup

which are then posted on the Backstage website.

This may at first have seemed like a risky step for some, but the decision to go with the creative flow has paid off in real business terms, providing direct access to a rich pool of ideas, pitches, developers and new prototypes for BBC services and and has paved the way for other initiatives such as the BBC Innovation Labs.

Chris Luebkeman, Director of Foresight and Innovation at Arup echoed his support for open innovation by emphasising the theory that there are more smart people outside of any company than within, and the key is to stimulate, attract and harvest ideas for the benefit of the company. He spoke of an executive decision by Proctor and Gamble that about half of their research and development should be sourced externally; a move that has been widely reported in the business press.

Mogens Laursen, Brand Development & Consumer Trends, Market Intelligence at Volvo, spoke about Volvo's beguiling creation: the YCC concept car, the first to be designed and developed entirely by women. The concept alone generated €400M of global media exposure. The key to this creation was that while the initiative came from the bottom up, it quickly secured funding and support from the top down. Mogens pointed to the need for change to stimulate innovation, "If you keep doing what you have always done, then you will keep getting what you have always gotten. Keep an open mind – and trust."

This session proved to be an inspiring exercise which imbued all with a sense of optimism and a motivation to seriously commit to innovation, but the last word of the day goes to Mogens Laursen who reminded everyone of important rule of three Ts when approaching innovation: Things Take Time... which of course they do, but with the help of successful and inspiring workshops like these, surely we are one step closer to achieving our innovation goals.

The next innovation workshop will take place in Spring 2008. If you would like to be involved please contact Carrie Montgomery at:
carrie.montgomery@arup.com
or Amy Lewis at:
amy.lewis@arup.com

SIR GEORGE COX

Sir George Cox held the post of Chairman of the UK Design Council from 2004 to December 2007, having previously been Director General of the Institute of Directors. He has spent most of his business career in IT: partly as an entrepreneur (co-founding Butler Cox plc, the consultancy and research group) and partly as a corporate executive (becoming UK Chairman of Unisys and heading its European service-based businesses). In 2005, Sir George carried out the Cox Review (of Creativity in Business), commissioned by HM Government.

Sir George currently holds a range of other posts, including member of the Board of NYSE Euronext, the global stock exchange group; Chair of the Board of Warwick Business School; non-executive Director of Shorts, the world's longest established aircraft manufacturer; trustee of VSO; and Visiting Professor at Royal Holloway, University of London.

Past roles include that of Senior Independent Director of Bradford and Bingley plc, Senior Independent Director of LIFFE (the London International Financial Futures and Options Exchange) and Chair of Merlin, the international emergency medical aid charity. He was also an international rowing coach and chaired the sport's selection committee for the 1979 World Championships and 1980 Olympics.

Q: What attracted you to the role of Chairman of the Design Council?

To be honest, I'd never thought of the role until I was approached by the search company that the Government was using. Indeed, I was rather a strange candidate, coming from a business and technology background rather than the creative sector. However, my well-aired views on the importance of creativity and innovation to economic success seemed to resonate with what they were looking for.

I suppose two things attracted me. The first was the challenge of doing something different (a recurring theme in my career) and the second was the chance to exert influence on thinking. When you feel strongly about an issue it's always more satisfying to be able to do something about it rather than just rant over the dinner table.

Q: Did you share the Government's view of the importance of design at the time?

Absolutely. I had already been hammering that view during my time at the UK Institute of Directors, where it was clear to me that the need for creativity in British business was pivotal to long-term economic health. There is very little that the UK can do cheaper than the rest of the world and we are relying too heavily on the City of London as a source of national advantage. Every field of business is now competing on a global basis and we have to find ways to differentiate ourselves from low-cost competition.

This message obviously struck a chord with Government because shortly after my appointment I was commissioned by the Chancellor to carry out my Review, looking at how to stimulate greater use of creativity in UK business.

Q: How important is design to business?

Research undertaken by the UK Design Council shows that two thirds of companies who ignore design have to compete mainly on price. In companies where design is integral, just one third do so. More than eight out of ten design-led companies have introduced a new product or service in the last three years, compared to just 40% of UK companies overall. This is compounded by the fact that 83% of companies in which design is integral have seen their market share increase, compared to the UK average of 46%. A business that increases its investment in design is more than twice as likely to see its turnover grow as a business that does not do so. The evidence speaks for itself.

Q: How did you approach the 2005 review of creativity in UK businesses?

Essentially, it was a one-man review, in that I was entirely responsible for the views expressed and the conclusions reached. However, the ideas weren't original. There was neither time nor the need to start with a clean sheet of paper. Moreover, I was supported by an excellent small team drawn

from different government departments. What we did was to consult widely: with business, trade bodies, central and local government and academia - indeed with anyone who had already given the matter serious thought. We also carried out surveys and commissioned a brief study in the Far East looking at the advances in the use of design in places such as China. To narrow the focus slightly we concentrated our efforts on the impact on SMEs (Small to Medium Enterprises) because that's where the greatest potential lies.

In terms of recommendations, we were seeking just a handful – I had a belief that dozens of recommendations left the door open to cherry-picking and no real action. We were looking for existing ideas that, if scaled-up, could have a worthwhile impact. We settled on just five. For example, we recommended changing the way that R&D tax credits were administered and also doubling the size of organisations eligible to receive the full value of such credits - both of which were taken up by the Treasury. We also recommended rolling out of a programme to help more businesses understand and exploit the benefits of good design. Piloted earlier by the Design Council, and now known as Designing Demand, the programme has subsequently been taken up by five of the national Regional Development Agencies and the other five RDA's have plans to do the same. It's already reached 1 000 companies en route to the Review's target of 6 000. We also recommended that new, multi-disciplinary Centres of Excellence be established at leading Universities to bring together the study of business, design and technology: disciplines which too often fail to have their real impact because of a failure to understand one another's roles and strengths. The new venture between Imperial College and the Royal College of Arts is an example of the outcome.

My original fear was of producing a worthy report that was well received but had no lasting impact. In practice, the effect has been far greater than I'd hoped, and the momentum is growing rather than subsiding.

The positive impact of design: each £100 that design-aware businesses spend on design raises turnover by £225.

Source: www.designcouncil.org.uk/factfinder

Q: Where is there still further potential?

The answer to this question is clear as far as I am concerned. It's the public sector.

The problems of society, whether they be in health, transportation, education, sustainability, whatever, can only be solved by new thinking: by creative solutions implemented skilfully. And I think the solutions are there. The problems are soluble. The trouble is that the public sector, with its emphasis on process rather than outcomes, its aversion to risk and its rule-bound procurement procedures, is very poor at applying creative thinking and adopting new ideas.

There's a growing awareness of the issue – not least because of political pressures to satisfy public demands for better services – but doing something about it is a tough challenge, particularly because of the scale of the problem and the cultural obstacles to be overcome. However, I expect to see progress. I wouldn't be surprised to see a public sector equivalent of Designing Demand emerging under my successor at the Design Council, Sir Michael Bichard.

Q: Isn't the UK a leader in design?

There is no doubt that the UK is a world leader in many aspects of design. That's true of architecture, fashion, product design and many, many other disciplines.

Our creative industries represent an increasing proportion of the UK's GDP and are respected the world over. We also have an outstanding record (not withstanding comparative under-investment in research) in invention and scientific discovery. My concern is that our businesses are not utilising these capabilities well and that we need to do so to prevent long-term erosion of our business base. UK business leaders need to incorporate design and continuous innovation into their strategies if they are to remain industry leaders in the years to come.

Q: Are other countries tracking what the UK is doing in design?

The problem that the UK faces is no different from that faced by most advanced economies.

Developing countries (which I think is an increasingly patronising term) have taken our low-skilled jobs because of their lower cost base. They are now increasingly competing for the high-skilled jobs and putting significant investment into developing their high-tech industries, research capabilities, skills base and design capacity. That means competition for everybody. That applies to every sector of business, and to services just as much as manufacturing.

The UK has probably given more recognition to this situation in recent times than most other countries. This is reflected in the fact that I, along with my senior colleagues at the Design Council, have been inundated with invitations to speak on the topic around the world.

Our challenge is to turn this recognition of the issues into real action – while we're still ahead of the game.

Q: Are there any links between design and climate change?

Climate change has, at last, permeated the consciousness of both world leaders and the general public. Sustainability will play a greater part in our future thinking and actions.

"The problems of society, whether they be in health, transportation, education, sustainability, whatever, can only be solved by new thinking: by creative solutions implemented skilfully."

Images courtesy of the Design Council

"Everyday I see new opportunities emerging in sustainable design. Arup can help link business, academia, manufacturers and the public sector to find real and unified solutions. As I say, these problems are solvable."

The challenge for design is to adapt our way of life to a new way of thinking without a drop in the quality of that life. We need to eliminate waste, to generate and use energy more efficiently and to travel far more efficiently. None of which is beyond the wit of man. Again, I believe the solutions are out there.

Designers need to become part of the solution rather than part of the problem. If the latter implication seems harsh, just look at the stacks of household goods or electrical products dumped every week because they have deliberately been made obsolete by new designs or at the piles of appealingly-designed packaging that surrounds all the goods we currently buy.

Clearly industry experts like Arup, working with the new Centres of Excellence can provide the holistic thinking and solutions to deliver low-carbon places to live and work. The design industry quickly needs to invest in whole life design, from inception to dismantling, in reducing the use of non-essential materials used in products, and in designing products that are more durable. Everyday I see new opportunities emerging in sustainable design. Arup can help link business, academia, manufacturers and the public sector to find real and unified solutions. As I say, these problems are solvable.

Q: What has been the best piece of design that you have seen recently?

You might expect me to rave on about my car or about a gadget or a building. All of which I could easily do. However, it is often the simpler things that most impress – and could have a more profound impact. Just think of the impact of wind-up technology in large parts of the third world.

I recently saw a pack of specially designed cards being used in the healthcare sector to help patients identify their symptoms before visiting the doctor. It enabled the patient (who may well be embarrassed or shy, perhaps not even speaking the same first language as the doctor) to spend time thinking about what the doctor might want to know. On arrival at the surgery, they simply hand over the selected, applicable cards, saving consultation time. It's ideas like that which could add to the effectiveness of the healthcare system, without requiring massive investment.

Q: What have been your career highlights?

A highlight for me is something from which I obtained real satisfaction – which may, or may not be a highlight in anyone else's eyes.

I suppose what gives me most satisfaction is seeing my handprint on an organisation. I don't crave reward or recognition. I just like to sense that I leave an organisation that bit different from the one I joined.

I've certainly been very fortunate to have had so much variety in my career. Forming a business was probably the most exciting thing, and eventually floating it on the stock market was hugely satisfying. Turning a company around, which I've done twice, is also pretty rewarding - but I wouldn't want to repeat the experience! Helping to modernise the Institute of Directors (a process that started before I got involved) was very pleasing, and I very much enjoyed my time at the Design Council. I think my sense of satisfaction from the outcome of my Review must be obvious from my earlier comments. It's a rare privilege to get such a public platform for one's views.

However, one of my highlights – a particular moment – didn't come from business. It came during a field visit I was making with Merlin, the charity that I chaired. Merlin provides emergency healthcare in crisis situations around the world and I was visiting a makeshift hospital in one of the conflict zones in Africa. I commented to my colleague, the organisation's chief executive, that it was remarkable that in such difficult circumstances we were able to treat some 200 patients each day. No, he replied, it's more than that, we save 200 lives each day. No single moment comes close. I've never felt more privileged to be associated with an organisation.

Q: What are your key strengths?

I think it's rather arrogant to claim one's key strengths. In answer to your question let me instead say what I'd like to think of as my key strengths. Others may disagree. There are only two.

The first is the ability to stand back and see a situation in perspective: to recognise what's really happening and identify what really needs to be done. That's a skill I think you can develop and I'd urge every executive to work at it. Think of how a situation would be summarised for a case study 20 years hence – because from that vantage point virtually every problem is soluble!

The second is a personal characteristic that I value in others and try to exhibit. That is consistency: to have values, attitudes and a way of behaving that don't vary from day to day or according to who you're with.

Q: What are your plans now, since stepping down as Chairman of the Design Council?

Nothing that I've ever done has arisen from sitting back and contemplating what to do next. That even applies to starting a business – which I did in reaction to my boss not wanting to adopt my plans for growing the company!

At present I've got plenty to keep myself occupied. Playing a part in helping to shape the world's first global stock exchange group is hugely exciting, as is helping the University of Warwick and its business school move further up the international league of academic institutions. However, if something really interesting came along...

SUSTAINABLE PRODUCT DESIGN

Extract, produce, use and dispose

How can designers and manufacturers compete with the rate at which material resources are depleting? It's a problem that affects the extraction, production, use, and end-of-life disposal of a product. Implementing sustainable practices throughout the product life cycle is the only real solution, and it is influencing change in material choices, design and production.

Finding new and abundant material resources is a priority, but these need to be durable enough for industrial use. Alternatives being investigated by Nikki-Ann Wensley, an Engineering Doctorate Researcher working within Arup's Sustainable Manufacturing and Construction Group, include materials that are biodegradable, compostable, of crop origin, recycled and recyclable. In particular, those which can be extracted, manufactured and disposed of with low environmental impact.

Despite the obvious need for a switch to new materials and technologies, lack of familiarity is preventing some companies from accepting change. Too often it is wrongly assumed that sustainable alternatives are likely to be too expensive or less durable than traditional materials. Nikki-Ann Wensley, says that in some cases sustainable alternatives are more cost effective: "As we realise ways of creating more with less material, the associated improvements in lean production make it easier and cheaper to maintain, repair, upgrade and eventually recycle products."

For designers and manufacturers, every breakthrough in alternative materials research is another opportunity to deliver cutting edge and future-proofed client solutions. As clients become more aware of this, demand for sustainable and economic solutions is growing. Arup's Product Design Group turns sustainable research into practice throughout the product life cycle. Products like our Technik floor and the Arup/Kinnarps desk are based on sustainable material choices, design and production to ultimately improve the performance of individuals and their businesses.

Technik Floor

Materials reduction and modernisation are both characteristics of the Technik floor, co-designed by Arup. The floor replaces traditional sand cement and gravel with 95% recycled board that provides enough support to allow the depth of overlaying stone tiling to be reduced by half. Time and cost savings are inevitable as the floor is more sustainable and easier to install because the two to three months drying time needed for a cement alternative is eliminated.

For clients, the Technik floor is a sustainable and economic solution says Arup Director and materials consultant, Bruno Miglio: "The steel pedestals are completely recyclable and the prefabricated nature of the 95% recycled board floor significantly reduces labour costs and lorry movements."

Arup/Kinnarps bench

The Arup/Kinnarps bench is a sustainable and economic design that uses an inner honeycomb layer of recycled cardboard sandwiched between two outer layers of hardboard to provide a lightweight and ridged table top. Manufacturer, Kinnarps has also developed a patented desk finishing called 'Lamine', a unique, rolled-on wood effect that is indistinguishable from real wood. This low-risk paint-type finish is applied directly to chipboard – itself a product of recycled waste – without the use of glues or veneer. It is a hard wearing surface that reduces the use of real wood veneers and glues used in traditional finishes without impairing recycling at the end of its life.

But the desk's sustainable credentials are based on more than alternative materials says Arup Product Designer Rebecca Minnitt: "The elimination of a metal sub-structure has decreased the cost of extra components and assembly time, and a simple adjustment system makes it responsive to modern business demands like hot-desking."

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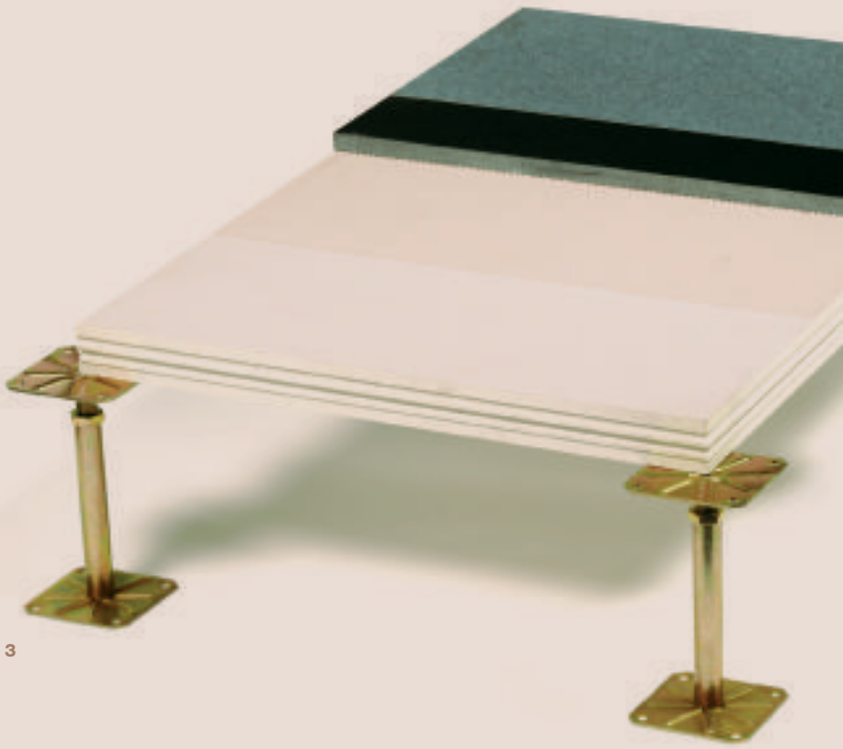

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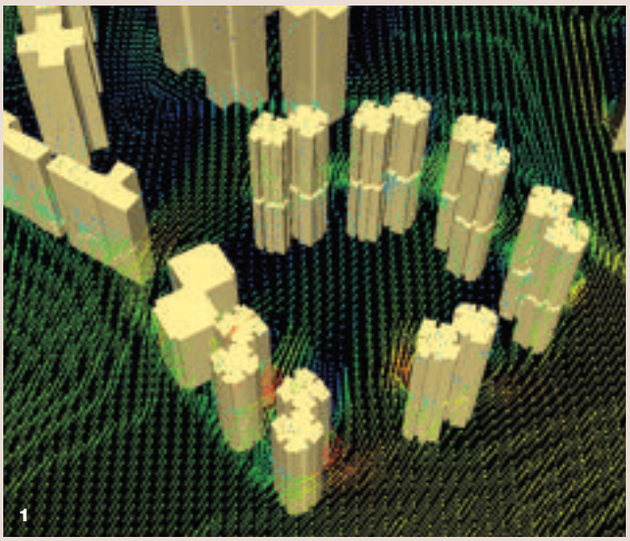
1 Installing the Technik flooring

2 Arup/Kinnarps bench Photographer: Richard Pullar

3 The Technik floor uses 95% recycled board providing time and cost savings

FACTORING IN THE WIND

Seminar: Tate Modern, London; 20th September 2007



1 CFD studies for flow around tall buildings

2 Development of an openable window façade system for high-rise buildings

3 High-rise building forms for increasing the natural ventilation potential

A seminar led by experts in the fields of urban development and wind engineering was hosted by Arup Advanced Technology at the Tate Modern in London, on Thursday 20th September 2007. 'City Development – Factoring in the Wind' was aimed at presenting the practical challenges and solutions to wind problems to the attending architects, planners, developers and owners.

With cities around the world developing at an unprecedented rate, high-rise buildings, energy efficiency, environmental quality and sustainability are all high on the agenda. It is important to recognise the significant impact this natural force can have on a development's performance, says Arup Wind Engineer Melissa Burton: "If a building directly faces an oncoming wind, strong winds from a high level will be brought down to ground level (a phenomenon referred to as down-drafting). This can result in difficulties using entrances or just walking in the street." Other microclimate factors such as sun and temperature should be taken into account at the same time as wind in assessing outdoor comfort, although this is rarely done at present.

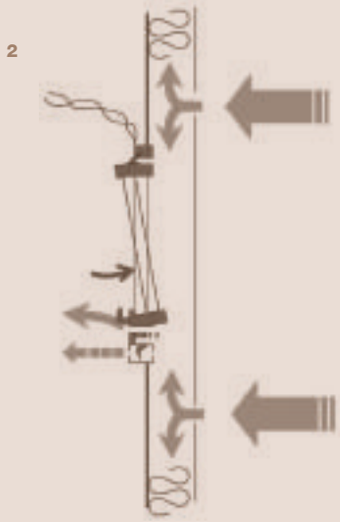
To measure how safety and comfort are going to be affected by wind, Arup consultants first assess the massing of a development, taking account of surrounding buildings and prevailing winds. Burton continues: "An experienced specialist can look at your development and identify the main windy areas and the easier solutions without further analysis." Obtaining and acting on these early predictions can often avoid problems that can be difficult to solve later even with the aid of wind tunnel testing.

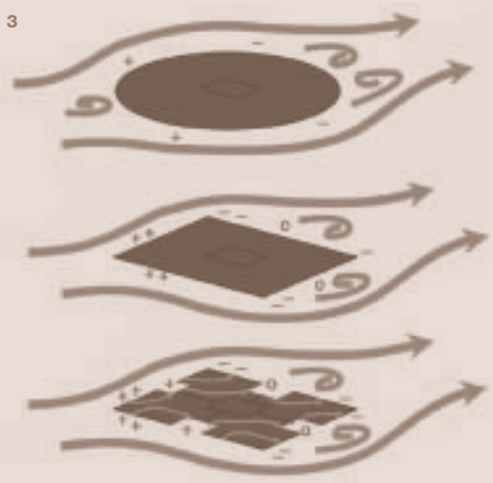
While reducing materials and cost makes a development more sustainable, the long-term energy use is also clearly important. The potential of wind power from buildings is still up for debate but the potential energy savings through avoiding the need for air-conditioning are huge. As Arup Sustainability Consultant Chris Twinn explained, "At Arup, we are pushing towards a future with more naturally ventilated schemes, but there is a debate over the institutional standards which govern the perceived acceptability of providing solely natural ventilation and cooling in high value buildings."

The technology for studying wind is currently limited in what it can do reliably. As Professor Ian Castro of Southampton University stated: "CFD (Computational Fluid Dynamics) modelling using Large-Eddy Simulation techniques (LES) is expensive on computer time but for urban environments does a significantly better job at modelling unsteady processes than RANS (Reynolds Averaged Navier-Stokes) CFD and agrees better with wind tunnel data. However, full-scale data doesn't always fit even the best current models". We will be exploring the limits of what CFD and wind tunnel testing can and can't do compared to full-scale for some time.

The recent Arup-hosted event on London's Southbank demonstrated how advancing technology is driving developments into how to harness wind in and around urban environments to achieve better sustainability. Debate rages on about the best methods, but factoring wind into planning and design is vital part of future-proofing any development.

Last year's Scruton Lecture at the Institution of Civil Engineers by Andrew Allsop, contains a description of the dynamic nature of wind behaviour and can be found at: http://scenta.interwise.com/etechb/portal/wes/default.asp?whichtab=2





PUBLIC TRANSPORT FOR THE 21ST CENTURY

An integrated Arup solution

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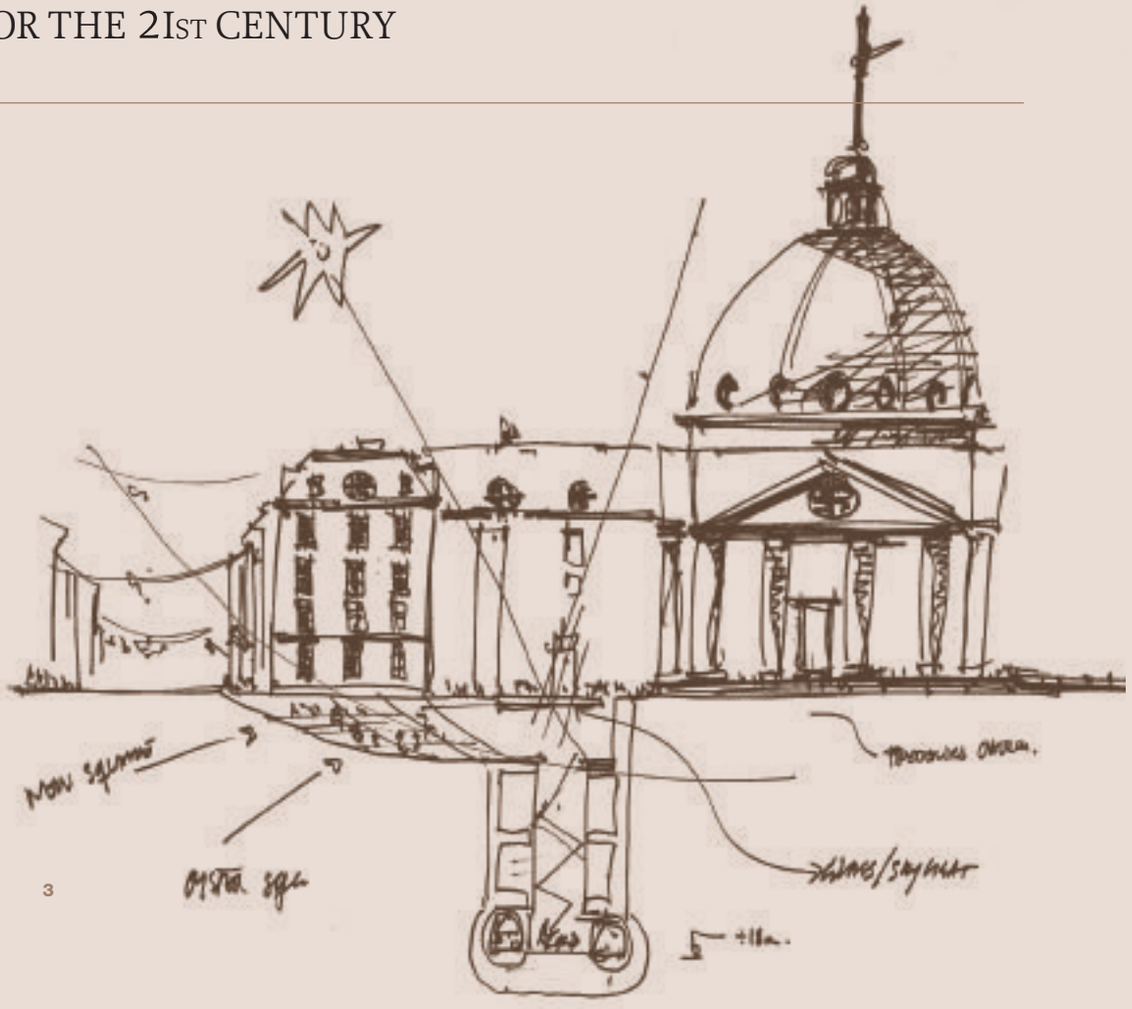

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1 The Metro's award-winning facade design features pyramids and skylights to allow daylight penetration © Adam Mørk

2 Surfaces can be treated to enhance the performance of daylighting

3 An initial sketch by Nille Juule-Sorensen for the Metro in Copenhagen

Imagine 2018: it is entirely possible that underground rail commuters will be catching up on the latest news by watching it live on tunnel walls – simply by activating an advertising space with a mobile phone. With this vision in mind, Arup is planning an interactive design for the 17 new, deep underground rail stations they have been commissioned to deliver for the Metro in Copenhagen.

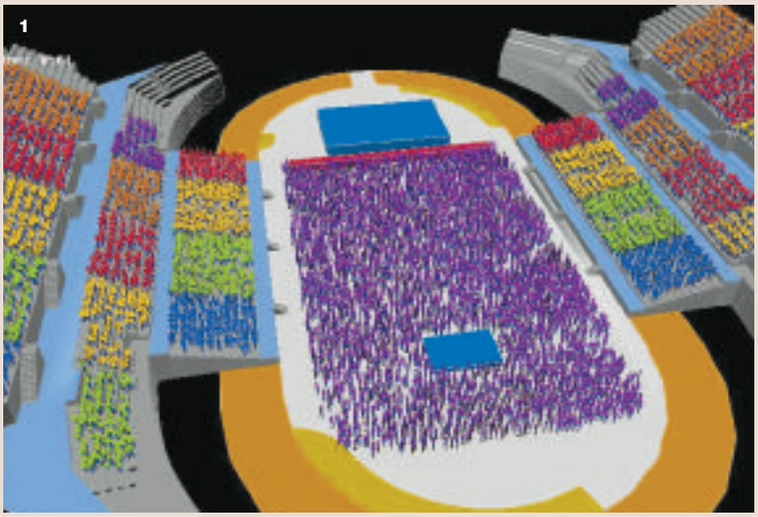
Using an integrated team of acousticians and lighting, facades and materials experts Arup is responsible for the full spectrum of architectural design, including wayfinding and product design. To make delivery faster and more sustainable, Arup is undertaking the full multi-disciplinary design of civil works in a joint venture with consultants COWI and SYSTRA.

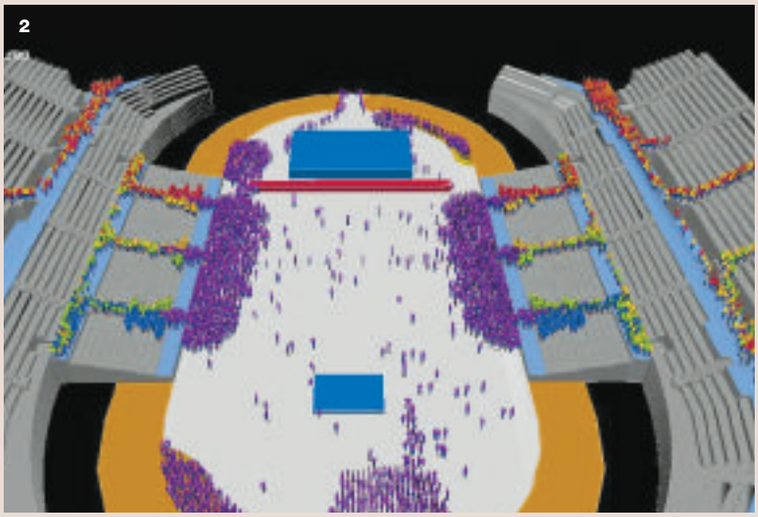
Arup's Nille Juul-Sorensen is the principal architect of the Metro's redesign and has been working on the project since 1995. He is now leading the multi-disciplinary team through a fourth phase of delivery that will specify everything, from ashtrays and benches, to advertising and station rooms for the 17 new stations. Our biggest challenge, he says, is beating client expectations: "Adding new design visions for a project that has already won international awards demands a solution that is state of the art, and better than anything we've already achieved."

The awards were won for a façade design that features impressive pyramids and skylights, and distinguished the Metro as the first underground rail system in the world to permit daylight penetration at platform level. As Copenhagen is a country blighted by heavy rainfall, the daylight enhancing design was greeted enthusiastically by the people of Denmark. Now the design team are focused on enhancing the performance of daylighting again by taking design to a new level, says Juul-Sorensen: "We are looking to build more interaction into tunnel walls by defining a system of spaces and surfaces that can be treated in different ways, as well as reflective surfaces that refract daylight and even change colour." With more interactivity, the design aims to encourage passengers to enjoy a broader relationship with public transport, making it distinctly '21st Century' and more commercially valuable for the client, train operators and advertisers.

ADVANCED EVACUATION MODELLING

Vodafone Arena, Melbourne, Australia





How is it possible to carry out an emergency evacuation study for a high-capacity, public venue like the Vodafone Arena in Melbourne, Australia, without physically involving thousands of people? Arup answered this question by simulating a full scale evacuation with 3-D modelling software for the Melbourne and Olympic Parks Trust (MOPT).

As a prominent landmark, the arena hosts regular high profile events and a large scale evacuation would have been impractical due to commercial concerns, safety considerations and a range of other issues. To avoid this scenario, Arup Fire engineers in Melbourne used the STEPS simulation software package and SketchUp, a new CAD tool, to create a visual simulation that the client could easily relate to the actual building.

The resulting 3-D model was based on 2-D arena configuration drawings supplied by MOPT. The client had expressed an interest in using visualisation of evacuation simulations to communicate key concepts and outcomes early in the project, and the results were a dramatic improvement on previous evacuation analysis carried out on the venue. The previously used system, AutoCAD, required significant upfront training, but Sketchup was easily picked up without formal instruction. This resulted in a significant time saving in converting 2-D CAD into a 3-D environment, with enough visual impact to ensure full awareness of how the arena would perform in an emergency situation.

After completion of the original scope of services, MOPT approached Arup to evaluate the effect of alterations to the venue configuration. Having been successfully trialled in the first round of simulations, Sketchup proved its worth again by allowing the new 2-D configuration drawings to be quickly integrated into the existing 3-D model. The team then ran new simulations with a range of scenarios, and reported results to the client in a short timeframe. With a range of detailed simulations and results as a foundation, MOPT has developed a fuller overview of the arena's exit provisions and identified where potential improvements could be made.

1 Vodafone Arena at capacity before evacuation simulation

2 Queuing patterns during evacuation simulation

KEY PERFORMANCE BENEFITS OF 3-D EVACUATION MODELLING USING SKETCHUP

1 Construction of a robust model has enabled future scenario evaluation to take place with minimum time cost for altering geometry and population numbers

2 Advanced suite of evacuation simulations were produced based on varied arena configurations, each with different population distributions that MOPT can use to gain approvals for future events

3 Visual quality of models allowed still images and video output to be produced and used for training of security staff for particular events

4 Issues identified in the Arup report can be visualised and related to the physical spaces with images rather than only words

5 Existing arena models can be easily modified to evaluate alternative arena configurations and the flow-on effects of opening additional paths of travel

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NEXT ISSUE

The drivers of change: how will business respond?

We are keen to ensure that this publication is enjoyed by our readers and provides interesting, relevant and informative articles.

All feedback is welcome, so please send your comments and suggestions to our editorial team at a2@arup.com.

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