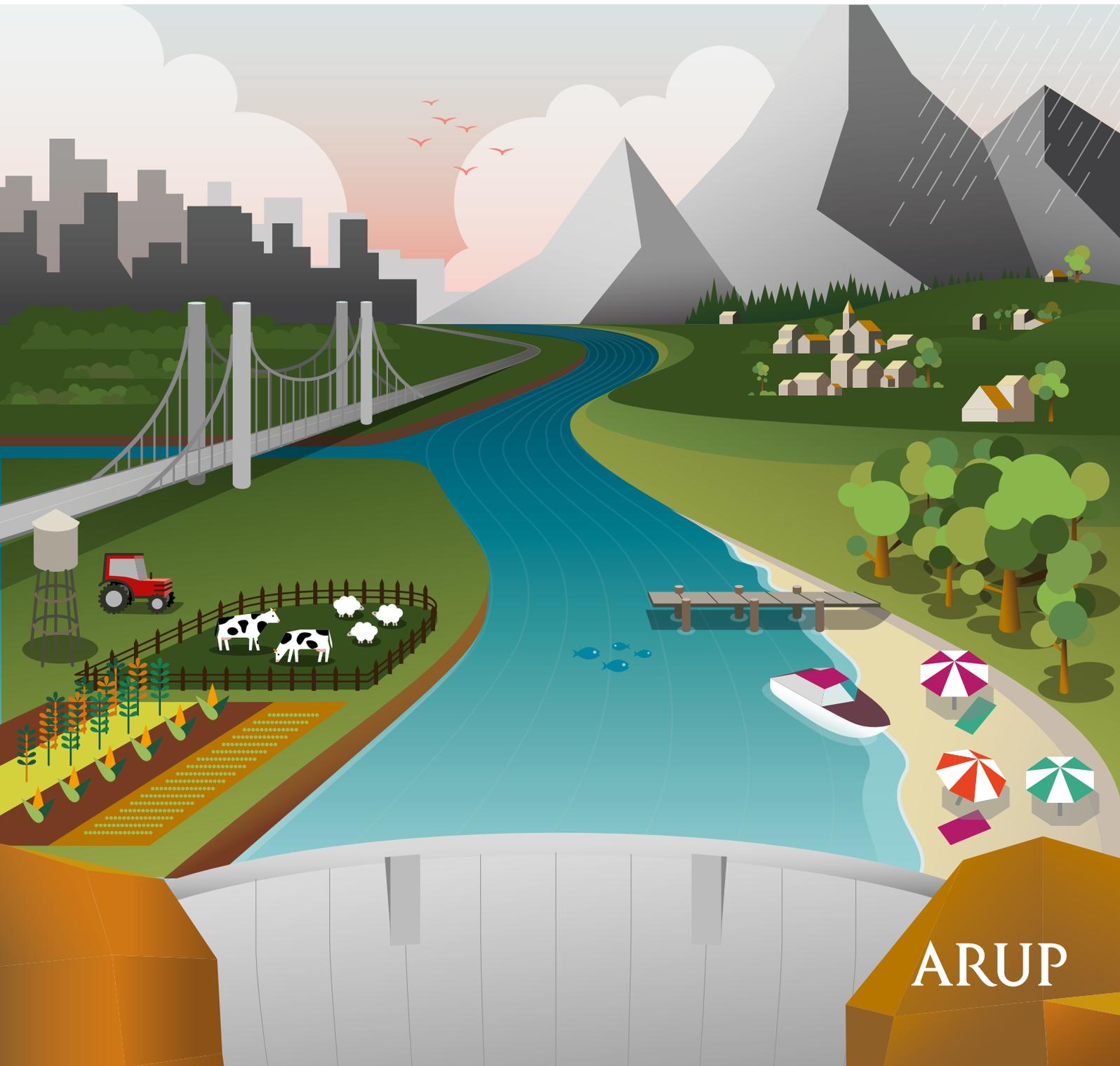


@4

Arup's quarterly review of
innovation, design and ideas.

Issue 11 | April 2015



ARUP

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Published by Arup in Australasia:
Level 10, 201 Kent Street Sydney,
NSW, 2000, Australia.
Editor – Stacey Ryan
Graphic Design – Amy Meldrum

Front cover image: © Ines Silva



I introduced the last edition of @4 with the belief that the engineering industry was on an up-turn, and when we look at engineering in cities, which we are particularly passionate about, the first quarter of 2015 has reinforced my optimism.

There are challenges ahead though, and so for the first edition of 2015, we are focusing on two areas of deep interest to both Arup and our clients. Water and digital technologies.

One is a vital resource that sustains life and the other is a new tool that should make our lives better. At Arup we are also working on combining the two to improve outcomes for both the health of our waterways and the communities they support.

Water is a critical issue in Australia, and worldwide, and in this edition of @4, we investigate how technology can help us manage this precious resource, and how the drive for something as prosaic as a swim in the river will push us to better manage our urban waterways. Also, dams and the myriad ways we rely on them are explained by our new Dams Leader, Dr Nihal Vitharana.

Digital technology is now almost fully integrated into our lives, so how can we make that work for us in ways we previously hadn't imagined? We investigate how the digital landscape and smart data usage can improve anything from your health to your commute home.

Some ground-breaking projects Arup have been working on have recently opened, including our own revamped Sydney office space!

We'd also like to introduce some exceptional people at Arup, Felicity Briody and Joan Ko, as well as welcome a new public transport planning expert into the fold, Brian Smith.

Finally, Arup was proud to be awarded the 2015 Financial Review Client Choice Award for Engineering Services, and we would like to offer our deep appreciation to our clients for that honour.

Kind regards,

Peter Bailey

Chair and CEO, Arup Australasia

Exciting new board appointment for Arup

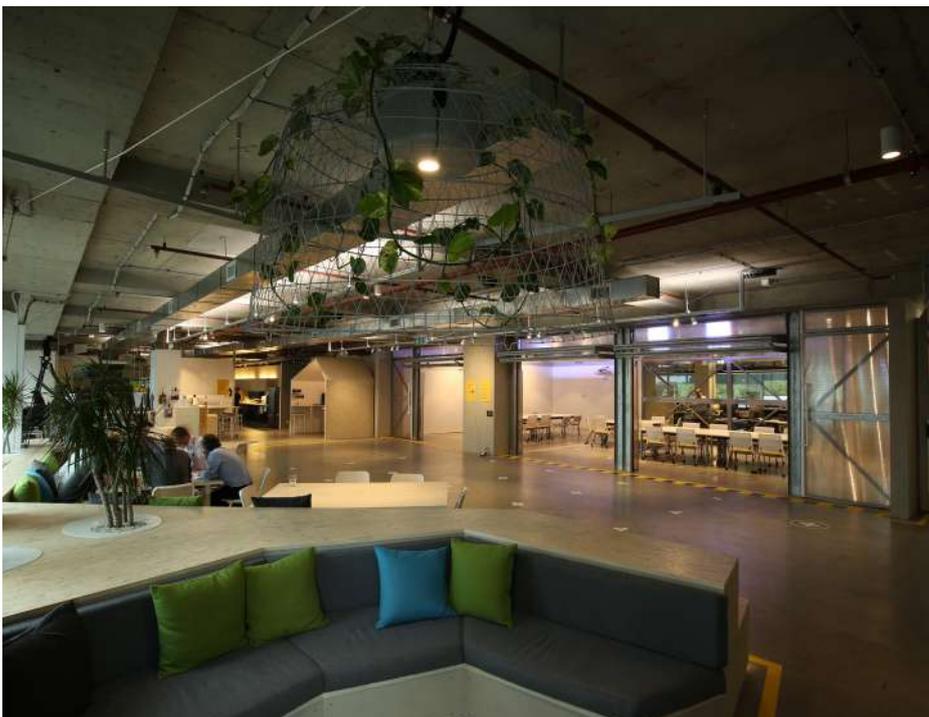
It is with great pleasure that we announce Rachel Nicholls' appointment to the Australasia Region Board.

Over recent months we have gone through a rigorous process reviewing candidates to ensure the Board has diversity of thought, understanding and experience to manage the operations of the Region, deliver value to our clients and strong business results. All Board members are expected to demonstrate a broad spectrum of attributes such as an understanding and view of the business in the Region beyond their immediate discipline, being able and willing to voice opinions, strategic

thinking, market success, business acumen plus they must have the respect of their peers and colleagues.

In Rachel's 25 years with Arup, she has lived and worked in three of our regions – UK and the Americas before moving to Melbourne in 2008. She has broad experience across our Transport and Resources business as a geotechnical engineer and design manager encompassing building foundations, basement excavations, offshore structures and, most recently, significant transport Infrastructure projects.

Rachel joins fellow Board members Bruce Tanner, Sector Leaders Paul Sloman, Peter Hoad and Ben Schnitzerling, plus Peter Bowtell, Marianne Foley and Wah Kam Chia. 



Arup's Sydney Office has launched a pilot study designed to implement the firm's new regional workplace strategy

The project has seen the complete refurbishment of approximately a quarter of the existing 5,536m² premises and acts as a pilot study ahead of a move to Investa's new development at 151 Clarence Street in 2018.

The new office space is shaped by Arup's values, promoting creativity and collaboration and the firm's design-led approach to work. Close consultation has ensured staff's motivations are at the heart of the project, while clients and collaborators are given the opportunity to experience that culture first hand.

The space represents a complete step change from Arup's existing workplace. Divided between a studio workshop and a new activity based working (ABW) 'neighbourhood', the space fosters openness, and the literal creation and design of things.

Award win

FINANCIAL REVIEW

CLIENT CHOICE AWARDS 2015

WINNER

Independently researched by
 beaton
RESEARCH + CONSULTING

“2015 - Best Engineering Firm” >\$200m

Arup was **recently awarded** Best Engineering firm (revenue greater than \$200 million) at the 2015 Financial Review Client Choice Awards – it’s the fifth consecutive year we have been shortlisted, and the second time we’ve won this Award.

It is such an honour, as client collaboration is an attribute we pride ourselves on, and to be acknowledged

for that by our clients is extremely rewarding. This reinforces the positive message Arup received at the recent World Architecture Awards when we were named most preferred structural engineers and second most preferred services engineer globally.

As you probably know the Financial Review Client Choice Awards are based on quantitative research into buyers of professional services, conducted independently by Beaton Consulting, and this year Beaton Research and Consulting received more than 27,500 responses from clients across various sectors. These clients were asked to rate the performance of firms they had worked with on a broad range of attributes including service, value for money, commerciality and innovation. It

is this aspect of these awards that makes them so unique and estimable, knowing the clients themselves are doing the rating.

The selection of the finalists and winners is determined exclusively by the data. There is no judging panel; it is the opinions of clients that count towards the Awards.

This is great news for Arup, our staff, and we’d like to thank our clients for their support. ☺

“Some might use a new workplace as a cultural change mechanism. For us, it highlighted the opportunity to create spaces that better reflect and enable characteristics that already differentiate us; innovation, creativity, and diversity. We want our office to encourage that; if we don’t fail in some way, we haven’t pushed the boundaries far enough.”

— Andrew Pettifer, Office Leader,
Arup Australasia

Bare concrete floors, garage doors, and studios characterise the workshop. The spaces are fitted with a range of integrated technology – media wall, 3D printer and range of projection and presentation options – and multiple modular collaborative stations.

Staff are given freeform space; adaptable, writable, mouldable; with the expectation that if they come to an area that has no fixed form, encouraged to participate, they will share, design and cross-pollinate ideas between disciplines.

Arup’s research and learning group, Arup University, sit at the centre of the studio, symbolically and literally at the heart of the new approach.

A complete Activity Based Working fitout for the firm’s consulting group branches off the studio space, fostering the free interaction of staff from day to day. It is believed this is the first instance of ABW being adopted by a consulting engineering firm in Australia.

“Our Consulting group is made up of a range of specialist functions. Working flexibly allows diverse teams to interact in a way that wasn’t possible before, increasing understanding of our skills, project work, and the opportunities that presents in how we service our clients. We are uncovering new ways of collaborating.”

— Marianne Foley, Principal,
Arup Australasia

The project will move beyond general workplace philosophy, utilising innovation from some of Arup’s specialist disciplines to monitor the change and better enhance health and productivity. Funded by Arup’s internal grant process ‘Arup Invest’, these initiatives hope to develop insights that can be incorporated into Arup offices and client projects worldwide.

Arup’s digital team are trialling Radio Frequency ID or RFID tags and bespoke Raspberry Pi nodes to track bay and workstation usage, and ambient and noise conditions across the length of the pilot. This will create a long term dataset which will help track the effectiveness of certain aspects of ABW. It will also provide real time feedback, displaying location of employees, bay occupancy and surrounding conditions.

Circadian rhythms and the effect of artificial light on the human body is an area of increased understanding in recent years. Arup lighting design experts are undertaking a trial lighting strategy within the space that complements the body’s diurnal cycle. By emulating natural daylight and colour temperatures, employee health, motivation and wellbeing can benefit.

The next 3 years will see an exciting process of experimentation analysis of staff experience to help deliver Arup’s ideal workplace. ☺

New Sydney workshop –
one day in one minute.

“No city so far has elected themselves to be a ‘dumb city’ ... but smart cities need smart governance.”

– Volker Buscher, Arup

With this statement, Volker Buscher set the tone for Sydney’s inaugural Shaping our City event. He outlined five key drivers, in political, functional, environmental, economic and social factors, that will be transformed by the integration of digital technology.



Sydney the smart city?

Volker Buscher



Sydney has a great opportunity to transform itself into a smart city in the coming years.

During my recent visit to Australia I attended Arup's first *Shaping our City* forum, where we looked at where Sydney is up to and the challenges it's facing.

I met people from government agencies, local council, and academia all working to make the best use of technology and data to make a more liveable, efficient and greener city.

Sydney has the chance to get on a really steep trajectory over the next few years. One thing to already be excited by is that when I travel from city to city to discuss the potential of these advances I'm often met with the request to lower the targets in the short-term, in Sydney the attitude was to expand and increase the targets!

While that is the case, my advice to the city's leaders is to be realistic about what you want to achieve in the

next 12 months, but to be much more ambitious than you currently are for the next five years – the medium-term future is often under-imagined.

And as Sydney goes down this path, the political leaders need to think about making sure all the data they collect enhances and doesn't detract from the lives and rights of its citizens.

All over the world, civic leaders are thinking about what it means to be a smart city. When I use that term, it encapsulates all the tools that cities are using, trends like social media, the Internet of Things (internet connected devices) and data analytics in five main areas.

These are:

- 1 Economic growth – Employing all this technology in a city actually creates jobs and growth. This is being recognised in places like

London, where the finance sector has traditionally been the main driver of employment. As digital capabilities increase, the city's mayor is now considering whether the tech sector should be the next area to grow strategically.

- 2 Understanding city constraints – Using the data to understand the functional constraints cities suffer and how to improve them, such as water use or transport. For instance, in Hong Kong's New Town development there's no room for cars, so authorities are using smart ticketing and payment systems and providing consumers with real-time information to make the public transport system more efficient and to encourage people to use it. This taps into a global change in attitude among young people, who no longer aspire to own a car, but instead want mobility as a service. Sydney is heading in a similar direction with its Opal card.



Above (L-R): Martin Stewart-Weeks, Dr. Sarah Barns, Volker Buscher, David Haron and Andrea Beattie at the inaugural Sydney Shaping our City event held at Carriage Works.



3 Environmental constraints – We can also use resources to measure and optimise our consumption of resources and the amount of pollution we produce. We will not be able to decouple increasing resource consumption from the economic and population growth in cities without using technology.

4 The social and care agenda – it's not just the young, mobile and highly skilled worker who can tap into the smart city. For instance, technology could help someone with early stage dementia stay in their home for another year by coordinating care and keeping them connected to sources of help. Or it could help organise a car pool so a single parent could do the weekly shopping in a single outing.

5 Political engagement – citizens have access to an unprecedented amount of data about their city and their place in it. On top of that social media means they can engage with the political leaders of a city like never before. For instance, people can now measure the air and water quality where they live rather than relying on the city for the information, or organise a huge online campaign about the closure of a small suburban fire station.

These five areas all create and rely on a huge amount of data about the city and its citizens and this is something cities need to think about.

The big issue that is hanging over the development of Sydney as a smart city – and indeed of any city that aspires to this – is what we call the humane city.

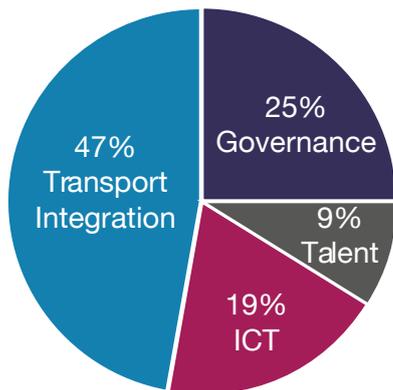
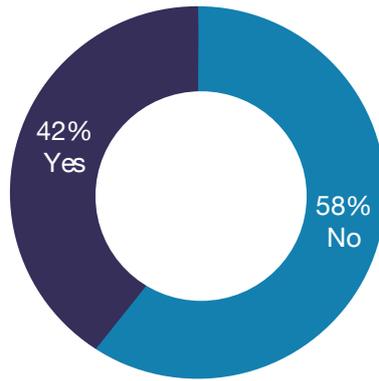
We need to avoid the mistake that city leaders all round the world made 40 or 50 years when they put up high rise towers made of concrete and steel that looked like innovation but weren't actually very good to live in.

We need to avoid building the equivalent of steel and concrete towers of data that instead of enhancing citizens' lives actually end up detracting from it.

The ubiquitous nature of the smart city will create data and transparency around an individual's life that currently the individual doesn't have control over because the data is owned and managed by others. Cities will have to develop a well thought out around what ethical or humane values for the digital city that deals with inclusiveness, privacy and trust.

Your say...

WOULD YOU CLASS SYDNEY AS A SMART CITY?



WHICH AREAS DO YOU THINK SYDNEY NEEDS TO DEVELOP MOST TO PROGRESS AS A SMART CITY?

“All the cities that have taken this on and have created two things, a political manifesto, where different parties argue what the digital agenda should be, and underneath it, a civic infrastructure that allows them to execute these digital manifestos have moved extremely fast and are aligned with the citizens. The other cities that have gone bottom-up, tech first, driven by industry; we’re highly sceptical where that will lead to.”

– Volker Buscher, Arup

Often it’s the context in which the data is used that can create problems.

For instance, no one wants information about how many times they go to the gym or what sort of food they eat to be revealed to their insurance company without their permission. Or if your fridge tells you that you’ve purchased too many fatty foods and you shouldn’t have that second beer, that’s a message you probably don’t want to get from your home appliances, however well meaning.

But if your fridge goes through your recent supermarket purchases and sends you a mobile phone alert that one product contains peanuts then that’s a service you’d be very grateful for if you have a child with a nut allergy.

The humane city is about finding the right balance between privacy and trust and your own security, and a better articulation of what a citizen perceives as valuable to them

We must remember that the city is owned by its citizens, they’re not employees. The smart city has to deliver its citizen experience or a human experience on their terms that they will want to be a part of.

This can be a problem for city leaders and politicians. Just as when the global financial crisis erupted, citizens didn’t blame the banks but blamed politicians for not properly regulating the banks, politicians will be blamed for the misuse of data even if it’s by private companies.

But it’s not an insurmountable problem. It’s just one that Sydney’s leaders need to be aware of and consider as they go down the path of becoming a smart city. ☺

Volker Buscher is a London-based Director in Arup’s Consulting practice and leader of the Information and Communications Technology business. His primary interest lies in developing a number of strategic viewpoints on smart cities, real time real estate, workplace strategy and vertical markets.

Arup can help develop a smart city in three ways. We work with cities to set their overall strategy and frame their digital agenda; we can design or provide insight into individual projects; and finally, we create insights for cities with their data by designing dashboards or visualisations of what’s happening across the city.

Shaping our City – Melbourne
Sensing City – Christchurch





Time for a dip – swimmable urban waterways

Michael O'Neill  

The idea of a quick dip in the Yarra or a plunge into the Parramatta River on a hot day is unthinkable to most Australians.

For as long as most of us can remember, our urban waterways have been far too dirty and polluted to consider swimming in.

Yet there's a growing push to clean up our city rivers so they become a genuine amenity and enhance the liveability of our cities.

The Urban Plunge movement, as it's known, is gaining momentum around the world and stems from the recognition that our rivers deserve our respect – think how many cities identify themselves by their waterways.

More and more rivers are being seen as natural city assets that we need to reinvest in. People are reconnecting with the waterways as urban developments make better use of them, freeways are being torn down, parklands are opening up, and walking and cycle paths are providing increased access.

Swimmability is the logical next step. But this is about more than just a nice place to have a dip on a hot day.

It changes the way a city looks and feels. In some ways swimmability is the last piece of the puzzle for cleaner waterways in our cities, and provides a concrete target we can aim for as we seek to improve our rivers.

If a city has got its urban waterways up to a swimmable standard then it's a sign that they've put in place all the elements needed to sustainably manage water running through the city and the associated benefits of this are almost limitless. From reduced urban heat islands to a thriving urban forest.

Firstly, it means they've stopped pumping water out of the river for industrial and other uses and stopped, or are effectively managing the discharging waste water back into the river. This has already been achieved in many developed nations, but stormwater runoff remains a significant hurdle to cleaner rivers.

With so many paved surfaces in our cities, the water that used to soak into the ground is now runoff. Combine that with the civil engineering approach of the past – that stormwater needs to find its way into a nearby waterway as quickly as possible – and you can see why runoff is such a problem.

Yet there's a growing recognition from urban planners and designers that stormwater is a resource and we should be holding on to it and using it in the landscape, for watering parks and gardens, toilet flushing, and other non-potable uses.

So instead of building big drains, planners and engineers need to start thinking about urban design that allows us to hold onto our water – more parkland and trees and schemes to capture and recycle the runoff.



Melbourne Surf Park, Vic

A new concept for a beach and surf park at the Central Pier in Melbourne’s Docklands is currently being developed by Damian Rogers Architecture and Arup.

The proposal, as yet still in concept phase, would offer Melbournians a beach lifestyle in the Docklands attracting locals, tourists and major international events

Image © Damian Rogers Architecture, Arup and Squint / Opera

Greenfield sites or redevelopments need planning controls to ensure developers change the way they deal with stormwater rather than getting rid of it as quickly as possible.

Many city rivers are also dammed upstream to provide a source of drinking water for the city and water authorities need to provide specific allocations for the natural river flow.

Change of mindset required

These ideas are gaining traction around Australia.

In Melbourne, turning the Yarra into a swimmable river is attracting interest from various stakeholders, though it isn’t yet government policy. A swimmable Yarra is probably many years away, but it’s something I’m very motivated to work towards.

Things are a little more advanced on the Parramatta River. The Parramatta River Catchment Group, which represents 12 local councils, has launched the “[Our Living River](#)” initiative and wants residents to be able to swim in the river by 2025.

But before we’re all jumping into our urban waterways, a couple of things need to happen.

First, we need a vision and a political will. Someone will be required to

champion the vision and provide adequate funding for the various actions required.

Second, we need a change in public mindset. The public believes our rivers are a lot dirtier than they are – in fact, some water quality experts say they’d quite happily swim in the Yarra if it hadn’t rained for a week or two, but that’s not a view that the public share. We’ll need a public education campaign to change these deeply rooted perceptions.

Options for swimmable rivers depend on the quality of the water and the topography of the river.

Swimming in our waterways isn’t a new idea. A stretch of the Parramatta River used to be such a popular destination it was known as “Little Coogee” after the famous Sydney beach and the Brisbane River housed various formal and informal bathing areas until the 1930s.

And as incredible as it might seem these days, the Yarra once held the world’s largest swimming event, the 3 mile Race to Prince’s Bridge, which used to attract more than 500 competitors. But it hasn’t been held

for many years because of pollution – in fact, it is currently illegal to swim in the lower reaches of the Yarra for public health reasons.

We’re making progress in Australia. Late last year we held a workshop on swimmable urban waterways here in Melbourne and brought in experts from all around the world. Delegates from parts of Asia and Eastern Europe told me how lucky we were that our rivers were in a state where we can even be considering swimmability.

Whether we’re able to achieve this goal or not it’s an aim worth pursuing and we’ll be better off just for having tried.

The public having safe and free access to public land and public waterways for me is a no-brainer and a basic right of all citizens. It will make our cities much better places to be. Moving in this direction will fundamentally change the shape of our cities. [📍](#)

Michael O’Neill is a Senior Environmental Consultant at Arup in Melbourne, with skills in water infrastructure planning, environmental planning and project management.

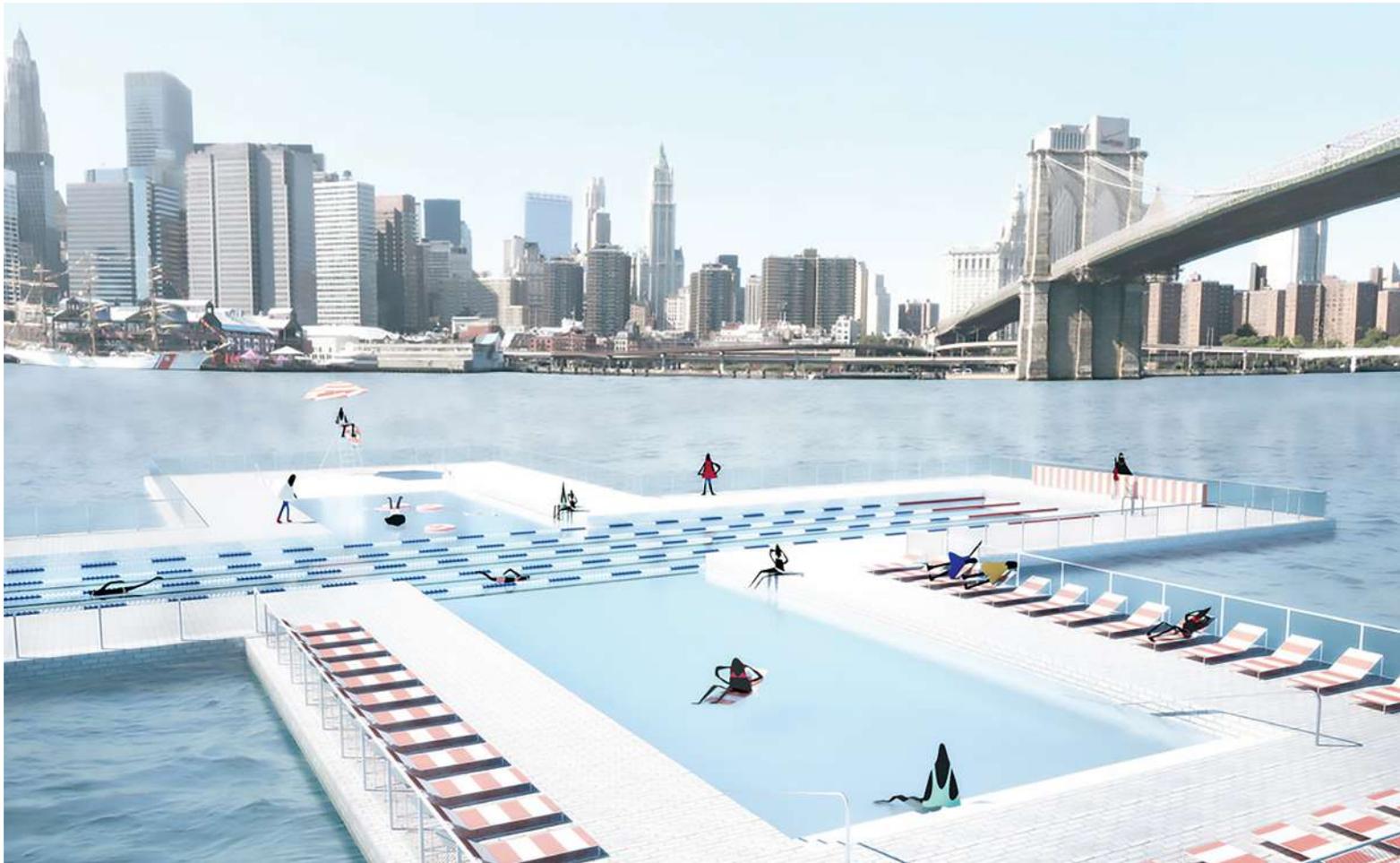
Image (page 8) Lake Parramatta Reserve, NSW © <http://freelancewanderer.com/tag/parramatta-reserve/>

CASE STUDY

In New York, for instance, the +POOL initiative is aiming to build a floating pool on the East River, which will be filled with filtered water from the river, but what happens if the river itself is clean enough so that no filtration is required?

In cleaner waterways, the swimming spot can become more a part of the river, with the potential for the river bank to effectively become a city beach.

Image: © pluspool.org





Beijing Airport Terminal 3, China

Terminal foot-print approximate overlay on Sydney CBD.

Images (L-R) © PID, 2015 Sinclair Knight Merz / Google Earth

Why airports will get smaller

Ronan Delaney  

By any measure, Terminal 3 at Beijing Capital International Airport is a massive structure.

It comprises about 1 million square meters of constructed floor area – equivalent to about a fifth of the total office space of the entire Sydney CBD where upwards of 500,000 people work / visit daily. And if you laid the 3.4 km terminal over Sydney, it would stretch across the city, from the Harbour Bridge to Central Railway.

But even [Beijing Terminal 3](#) is not the world's biggest airport terminal building. That title goes to [Dubai Terminal 3](#), which opened only a few months after Beijing in 2008.

Airport terminals are designed so they can cope with the busiest hour of the forecast travel in a city gateway, and as more people have taken to the skies, terminals have increased in size to meet that ever growing demand. So a major airport might have 60 million passengers coming through a year and be required to have the capacity to accommodate 60,000 people in the terminal during that peak hour.

Yet the terminals in Beijing and Dubai are potentially getting to the high point of the trend towards huge airport terminals for major international gateways.

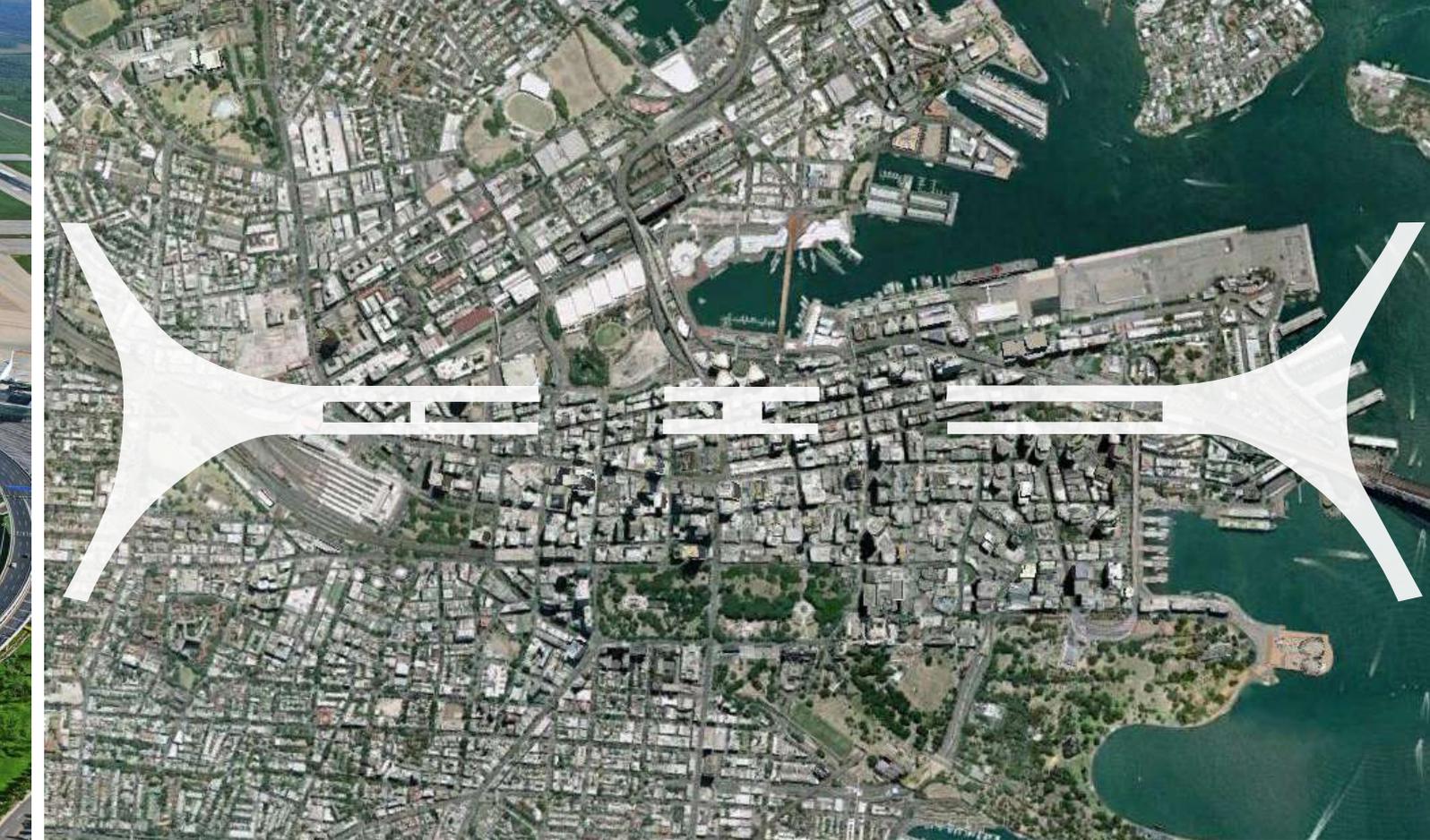
Terminals will get smarter and smaller as communication technology allows passengers to move more quickly through airports requiring less queuing and waiting time, and hence reduces the peak demand number of passengers having to be accommodated in the terminal.

This trend will continue even as air travel (in particular in Asia) continues its rapid growth.

The smarter, smaller / leaner terminals will not only be cheaper to build and operate and have less impact on the environment, they'll also provide a more convenient and better tailored customer experience.

My recent experience at the Qantas domestic Terminal 3 is a good example of how the technology is reducing the time business passengers have to spend in the terminal.

When flying domestically in Australia, I used to leave home two hours before my flight. Now I'm able to leave an hour or even a bit less before my flight is due to take off. The major bottleneck was check-in queue, which created a backup at the terminal doors while passengers got out of their taxis and unloaded their bags, and this back up in turn spilled out into the traffic network, with large numbers of taxis / cars queuing just to drop off their passengers.



But Qantas' introduction of Q-cards for check in and Q-tags for baggage has slashed the queues. Instead of queuing for check in, I swipe my Q-card and receive a text message telling me my seat and gate number. And I just leave my bag at a Bag Drop because it has a Q-tag, which like the Q-card contains near field communication technology so it can be electronically identified and tracked.

This also means that Qantas can better track where I am in the terminal building. This means fewer delays and a reduction in congestion while they try to find a missing passenger.

These changes have probably increased the T3 effective capacity by about 30 to 40 per cent and it potentially saved Qantas from having to build another pier or terminal.

A New Way To Build Badgerys Creek?

Terminals being built from scratch have even more to gain from these efficiencies.

Dubai World Central Al Maktoum International Airport, currently under design and construction, is being planned to handle up to 200 million passengers a year. Under the old model of airport terminal, this would have required a gargantuan building of about 7 - 8 million square meters at a cost of tens of billions of dollars.

Instead Dubai Airport asked Arup and some other firms to consider what the airport of the future could look like. The result will be a system that will see most passengers check in and deposit their bags at a city railway station before they board the train for a relaxed ride to the airport. The passengers will arrive, they'll already have their boarding passes, and their bags will have gone on ahead of them, so they'll walk through security / passport control and go straight to right part of the large terminal where their gate / aircraft will be ready for them.

Under such a design, the terminal could be a lot smaller, at about 2 million square meters, and it will cost a lot less to build.

These advancements don't just save on terminal space. The reduced scale and travel distances as well as the new technological advancements will also improve the overall customer experience.

Take dining in an airport, for example. In many airports you might wander around a food court, queue up and order your food, then walk around with your tray looking for a free table. Often by the time you've found one you have to rush your meal because your flight is boarding soon.

At **Terminal 5 at JFK** in New York JetBlue have come up with a potentially clever solution to this problem. Instead of queuing for a meal, passengers find a table, sit down and scan in the barcode of the meal they want from a digital menu. The order is automatically charged to their credit card / or electronic payment system and the order is sent to a central kitchen which prepares and delivers the meal – with plenty of time for the passenger to make their flight because that data was also included in the order.

Retail also has the potential to use the terminal space more efficiently while at the same time providing a better customer experience. Rather than having just the traditional type shopping experience, terminals could feature “activity walls” with product placement. They’ll detect passengers’ presence through their mobile phone with near field communication and tailor offerings to their needs and preferences. Perhaps a sports fan on the way to Melbourne for the weekend might be offered AFL tickets?

These approaches together with the creation of facilities better tailored on a human scale with a lot of natural light, generous seating areas at the gates and clear and intuitive wayfinding inside the terminals will create a welcoming and pleasant environment for travellers.

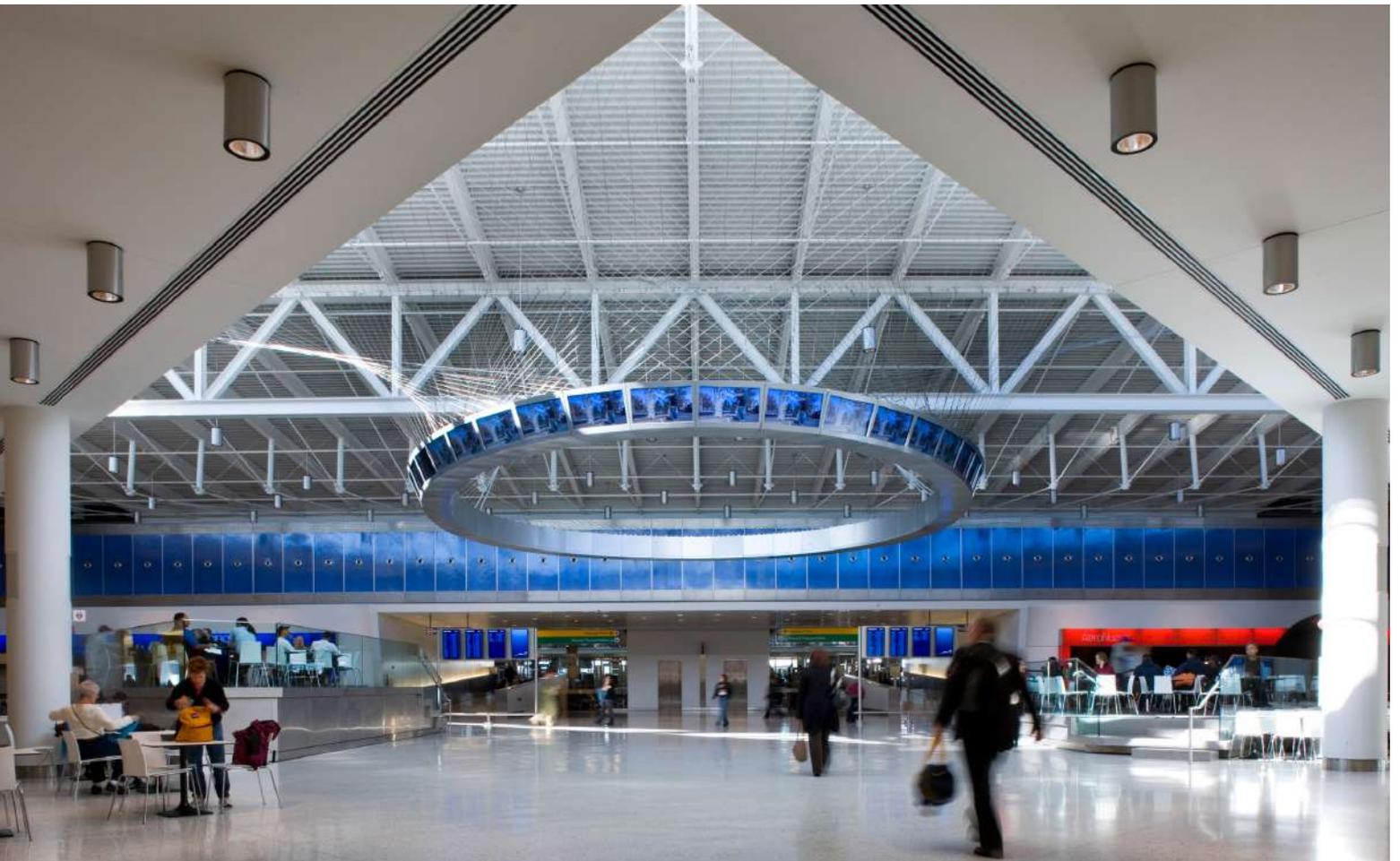
All of this technology opens up interesting possibilities for the proposed new airport at Badgerys Creek in Sydney’s West. One possibility is to have passengers check in remotely at Liverpool, Parramatta and Penrith city centres. They could leave their bags at these intermodal hubs in the nearby CBDs, attend a meeting or perhaps do a bit of shopping then as their flight time approaches, travel to the airport by pod, similar to the ones currently available at Heathrow Terminal 5.

It’s this sort of forward thinking that will mean that Badgerys Creek Airport isn’t just appropriate for the mid-2020’s when it opens, but it will be a facility that serves the people of Western Sydney and greater New South Wales well beyond the 2050 design horizon that it is currently meant to. 

Ronan Delaney is the Aviation Business Leader for Arup in Australasia.

With over 25 years of design and construction experience of major international projects. He has worked extensively in both Aviation (Airports) and Rail industries.

Images (below L-R): JetBlue Terminal 5, JFK Airport, New York, USA © Nic Lehoux Gensler, Heathrow Terminal 2 Airport, London, UK © Arup, Beijing Capital International Airport Terminal 3, Beijing, China © Frank P Palmer



Airports and passenger-centric design

Simplicity and clarity are particularly important in airports because people don't always behave logically when they're stressed or in a hurry. Continue the conversation at [Arup Thoughts](#).

Image: SkyPlaza Terminal 2, Hong Kong © Arup



Communities need more from their dams than just water

Nihal Vitharana  

Many of Australia's dams were built 40 or 50 years ago and have served their communities well.

They were built with the one purpose of storing water and this of course remains their primary function. But they're now being used for other purposes as well, including flood mitigation and climate resilience. On top of this, dam safety requirements have increased.

All of this means that dams throughout the country are undergoing major upgrades to meet the new requirements. Dams are being retrofitted with the cost running to several hundred million dollars.

For instance, the NSW State Water Corporation, which manages dams in rural areas, has several dams which need some level of retrofitting to boost their safety and increase their storage capacity.

Driving the higher safety requirements are upgrades to their maximum probable flood levels. These are the floods that would result from a combination of the worst possible hydrological and weather conditions, and while they're one in a million year events, they still have to be planned for in dam safety.

Advancements in forecasting techniques, such as improved definition models and better understanding of

how meteorological and hydrological factors interact, mean that in Australia these levels are on average about 40 per cent higher than the original estimates.

Flood mitigation is also coming in to play, with the Queensland floods of 2011 highlighting its importance.

Those floods were a one in 120 year event flood, and if a similar flood happened in the Warragamba Dam catchment area to the west of Sydney, the insurance bill alone would be many billions of dollars, let alone any injuries or loss of life. Also, the 1.3 million residents of the Penrith Basin would have to be evacuated – and anyone

Community education programs

Withstand 1 in 120 year weather events

Improve regional transport infrastructure

Improved land use planning

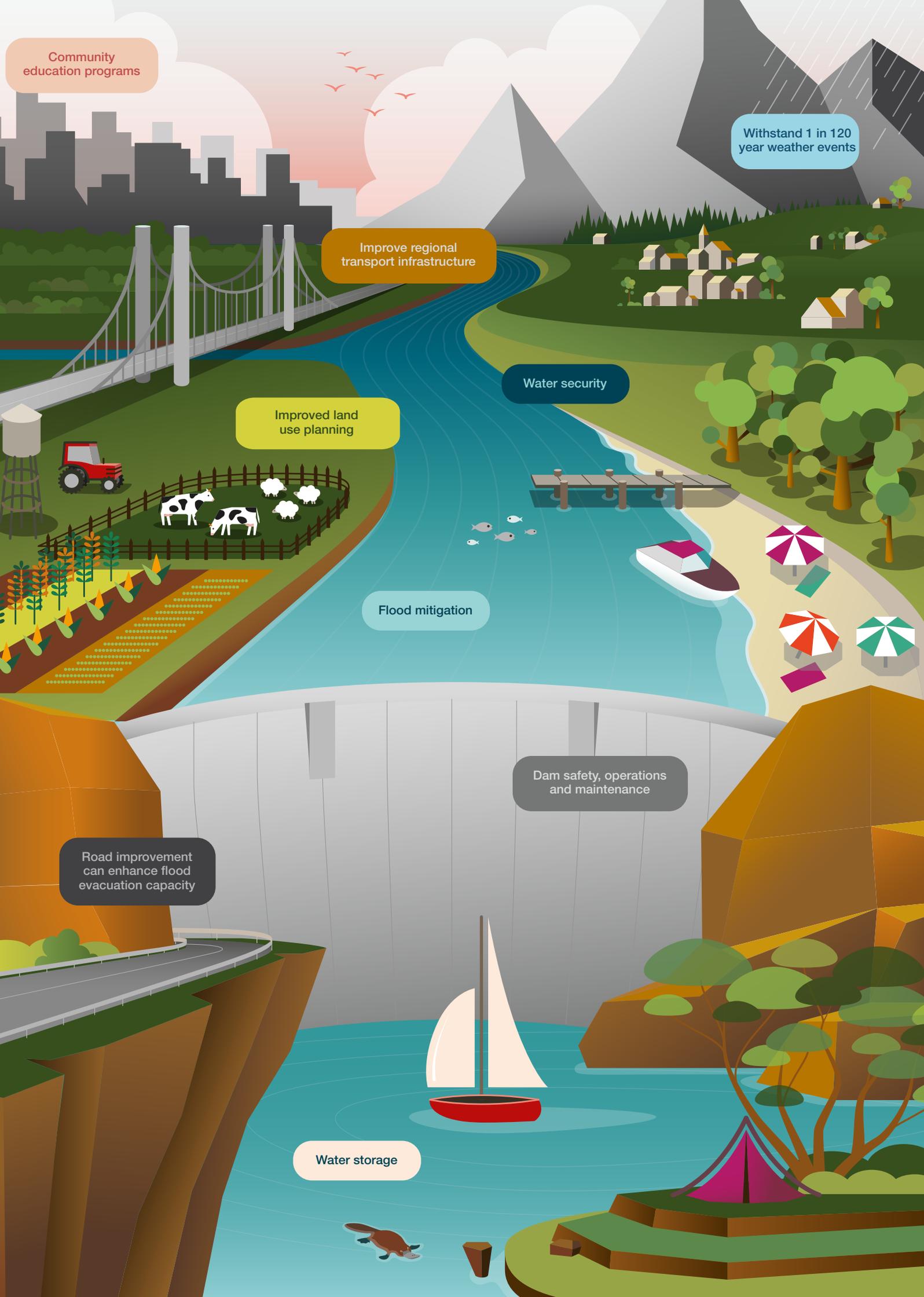
Water security

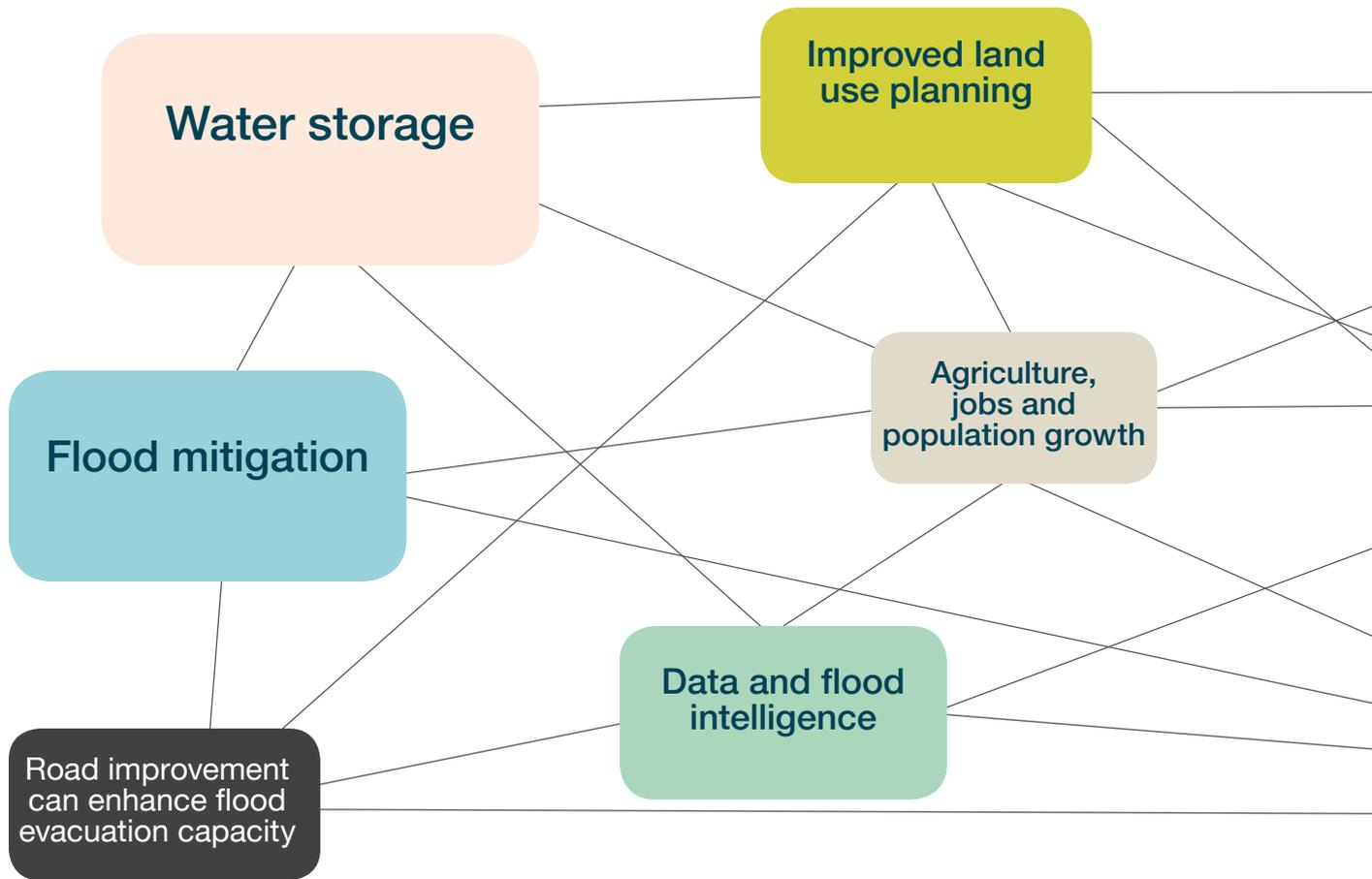
Flood mitigation

Dam safety, operations and maintenance

Road improvement can enhance flood evacuation capacity

Water storage





who's ever been caught in peak hour traffic in Western Sydney knows what a massive task this would be.

Infrastructure NSW is working on the problem, with a [report](#) released in November last year suggesting \$1 billion be put aside to upgrade water infrastructure in NSW to adapt to climate variability and provide water security, as well as flood mitigation in the Hawkesbury-Nepean Valley, where Penrith lies.

The flood plain has seen significant population growth since 1990, accompanied by the necessary housing, commercial and industrial development and provision of infrastructure, and this (the report says) makes flooding in the valley the highest major infrastructure risk in the Sydney metropolitan area.

One possibility canvassed in the report is raising the dam wall.

Retrofitting dams to boost their safety and for flood mitigation is a major undertaking, and like most large construction projects is always at risk of cost overruns.

More Planning Equals Fewer Mistakes

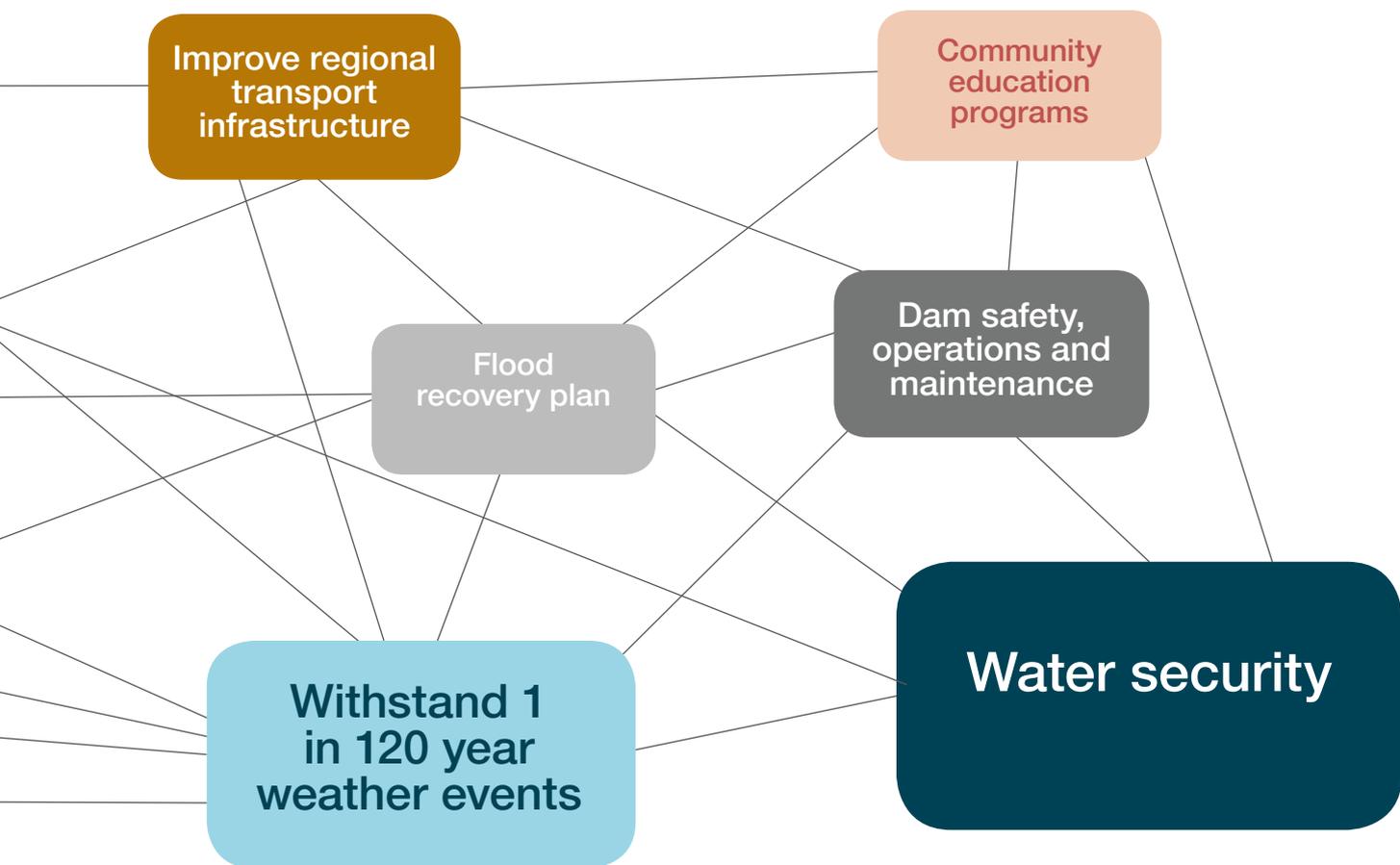
In fact, researchers at Oxford University examined 245 large hydropower dams in 65 countries built between 1934 and 2007 and found the costs of dam construction were underestimated by 96 percent on average, and that construction times were 44% longer than first estimated.

Often this is the result of poor planning and insufficient investigation before the project begins.

The more investigation and planning that is done at the start of a water infrastructure project, the lower the risk of significant cost overruns.

Even seemingly small errors can be costly when dealing with projects of this size. For instance, when the strength of the foundation rock is assessed, making an error in measuring the so-called “[angle of friction](#)” can increase the cost of the work by \$10 million or \$20 million, or alternately mean that the completed project isn't up to the standard it should be.

Or consider a project that requires 100,000 cubic metres of concrete. Not taking account of the environmental regulations governing how it's to be transported (let alone those governing its use on site) can be a costly error. The local council might dictate that to minimise disruption to the local community the concrete has to be trucked in between 9pm and 3am, and that trucks need to be covered with sheets and roads watered down to reduce dust. All of this adds cost and time to a project.



This is why a multi-disciplinary approach to dam planning is needed. Disciplines that need to be involved are environmental engineering, hydrology, geology, geotechnical expertise, hydrogeology, structural engineering, hydraulics and materials engineering, to name a few. Even road designers are sometimes needed – when a dam wall is raised new routes to the dam wall need to be found.

I like to say that a dam is often smaller than the sum of its parts!

Upgrading a dam’s flood mitigation can also open the way to release land below the dam wall for housing or business use. As with other upgrades to water infrastructure, a full cost benefit analysis is needed before work can begin. Water authorities need to weigh up the cost of the dam upgrade against how much money could be raised from releasing land.

And of course, the more densely populated an area the more valuable the land but the stakes are also higher in the event of a flood.

Dam capacities are also being expanded to meet the needs of growing urban populations and assist with climate resilience. It’s also possible to make better use of existing dams, by transferring water from one dam that is at or nearing capacity to another which is less full.

Once again, before water authorities embark on the expense of transferring the water they should do a full yield analysis. This involves putting a price on each cubic metre of water then working out the total cost of spilling that water when the dam reaches capacity compared with the cost of transferring it to another dam.

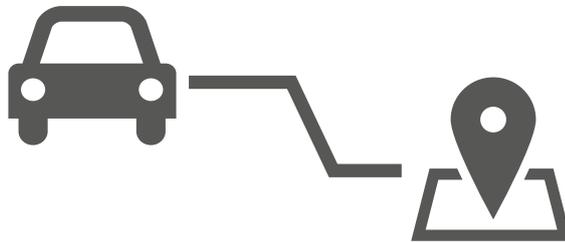
Water projects are the same as many other infrastructure projects: more planning and investigation at the beginning means faster delivery, a lower cost and a better piece of infrastructure. ☺

Dr Nihal Vitharana is Dams Leader for Arup in Australasia. He has 32 years of international experience spanning dams, structures, geotechnics, earthquakes, water resources and infrastructure.

Details of our dam engineering service and examples of key projects where we’ve met even the most complex challenges.

Images: ©Ines Silva





Smarter roads for better travel

Kerry Farley  

Thousands of Sydneysiders use the city's M4 motorway to get to work every day – but I think all drivers familiar with the road will agree there could be improvements!

Residents of Western Sydney could spend anywhere from half an hour to an hour and a half to commute to work, making planning the day a real challenge. Aside from the day-to-day issue of just getting to work on time our lives are more complicated than that. Will you make it school to get your kids in time for soccer, and can you make it to the store to buy dinner? Alternatively, could you sit waiting for your partner at the train station because you arrived too early to collect them?

Fortunately, NSW Roads and Maritime Services is working to fix the information problem using intelligent transport systems in its M4 Smart Motorway project.

Intelligent transport systems (ITS) use data from transport networks to improve the experience of the network users, be they rail passengers, motorists or even shipping companies.

They work in two ways, by giving the users more information – for instance by giving them real time data on when the next train will arrive – and by using that data to adapt the network to best suit the users.

On motorways, this involves measuring the speed and density of the traffic then altering the speed limits with electronic signs and regulating the amount of traffic joining from side roads using the traffic lights system (SCATS). The aim is to keep the traffic flowing as smoothly as possible and avoid traffic stoppages.

Recent developments mean that the existing technology is being better deployed. We've discovered that we can get better results by pulling together multidisciplinary teams to work out where to best place the road sensing and traffic controlling equipment.

This means we can virtually eliminate those mysterious traffic jams that seemingly appear from nowhere, leaving motorists wondering if there's a crash or a breakdown up ahead, only to find there's nothing to see once they get going again.

CASE STUDY

Intelligent Transport Systems on Melbourne's M1

Intelligent Transport Systems can deliver great results for road authorities, as we saw after the upgrade of the Monash-City Link-West Gate Upgrade.

This road system comprised the main 75 km east-west arterial road network across Melbourne, but it was running at capacity.

As Vic Roads noted, congested freeways rarely put through more than 1500 vehicles per lane per hour. Its Managed Freeways Project achieved a 30 per cent higher vehicle throughput.

Arup provided technical design and specifications for the FMS project, including the largest coordinated ramp signalling scheme in the Southern Hemisphere.

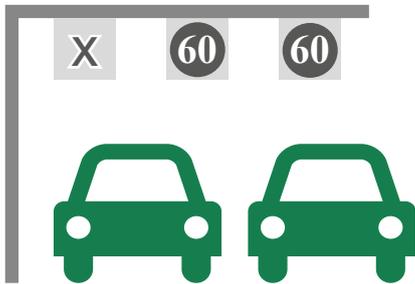
This involved coordinating 64 ramp signalling sites and all the related devices – including ramp signal controllers, traffic signals, wireless vehicle detection, CCTV, ramp meter variable and changeable message signs, and associated ITS infrastructure.

Ramp release rates are now altered every 20 seconds to help make the most efficient possible use of the road.

Vic Roads said the end result of the ITS upgrade and additional running lanes was that traffic volume increased about 30 per cent per lane and speed was up about 25 km/h.

Image: © Arup

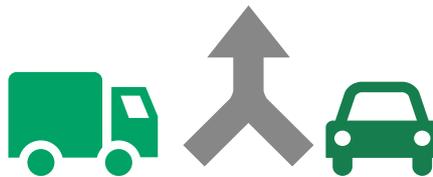




Real-time information about traffic conditions and expected travel times would allow drivers to make informed decisions about travel routes before entering the motorway and once on the motorway.



Traffic keeps moving on the motorway so journey times are slashed by up to 15 minutes.



Entry ramp signals would smooth the flow of traffic onto the motorway and allow safer merging.

Source: <http://www.rms.nsw.gov.au/projects/sydney-west/m4/benefits.html>

These traffic jams are often caused by other vehicles entering the motorway, forcing cars already on the motorway to break to let them in. A wave of breaking travels back down the motorway as drivers behind slow down, so that 10 minutes after the first driver braked at a merge point there'll be a flow breakdown about 500 metres back down the motorway.

It might sound counterintuitive, but the motorway traffic jams caused by more cars joining the motorway can be resolved by slowing down the traffic and regulating the flow of cars into the road.

If cars are zipping along the road at 110 km/h then the drivers will have to apply their breaks to let cars from side roads merge. But if the speed limit is reduced to 80 km/h then other vehicles can merge without any breaking – and hence without any traffic jam.

Slower Roads Carry More Cars

There's another benefit to slowing the traffic – higher traffic throughput. Travelling at 110 km/h, the distance between vehicles is, say 10 meters, but if the traffic is slowed to 80 km/h, that distance can contract to, say, 6 or 7 meters, allowing more cars to be on the road at any one time.

ITS on roads also involves regulating the amount of traffic that joins from side roads with signals and lights on ramps leading to the motorways to ensure that the joining traffic doesn't overwhelm the existing flow.

Ramp signals are coordinated. It's not good holding back traffic to ease the flow at one point then flooding the motorway a bit further along, so the signals need to "talk" to each other and adapt to the changing traffic speed and volume.

This is how intelligent transport systems can help smooth out the traffic variation. M4 users won't get to work in 25 minutes, for instance, but with ITS they can be confident that on most days they'll get there within 40 minutes. And numerous surveys have shown that motorists would rather have certainty over their travel time, even if it's slightly longer than the best time.

Intelligent transport systems aren't about new technology. Instead, they're about how well we understand the existing technology and how well we use it.

This is true of the road traffic management. ITS covers electrical communications, civil infrastructure, traffic and transport engineering and modelling and the best results are achieved when experts from all of those disciplines work together.

For instance, one of the key factors in traffic management is where to place the equipment – the sensors, the cameras and the variable speed signs. Design specifications might require road sensors to be spaced at 500 meters apart, but there's often a better way of doing it, depending on the topography and direction of the road.

ITS projects help transport authorities make best use of existing infrastructure. They're not always cheap, but they're a lot cheaper than adding another lane to an existing motorway and can extend the life of a road for a decade before it needs to be upgraded or added to. ⁴

Kerry Farley leads Arup's Australasian Intelligent Transport Systems group. He has 11 years of ITS experience in the UK and Australia and before that served 13 years in the Royal Navy as a Weapons Engineer.

Image (page 24): Aerial view of the M4 Motorway looking east, Sydney, NSW © Beau Giles (<http://www.flickr.com/photos/beaugiles/5244511909/>)

Technology on tap – managing our water better

Daniel Lambert   

At Arup we've been considering how water will be used and managed in Australia and globally in 2040.

Our study, [The Future of Urban Water](#), outlines four different scenarios for how water authorities will manage the resource and how consumers will access and pay for it.

Each is very different, with very different outcomes, but the one thing they all have in common is that technology will have a huge impact on the way we use and manage water, both for individual households and for water authorities.

While the study was undertaken in collaboration with Sydney Water* and considers how water will be used in 25 years' time, it's a good starting point to think about how all cities will manage their water resources in the future.

Water authorities need to understand what some of the future scenarios could look like so they can plan for them and make their own water systems resilient and adaptable, because if they're not looking ahead, they'll face challenges down the track.

The four scenarios we identified are:



Incremental Improvements

This scenario entails a focus on customer services that are user-centric and provide greater personal choice and control over service levels and pricing. It requires higher levels of cooperation between water, energy and telecommunication companies with a focus on integrated planning and maintenance.

Better Together

Here there is an emphasis on creating a seamless customer experience across multiple integrated utilities,

including shared billing, pricing and customer services. Better cooperation between urban utilities through collaborative planning, integrated asset management, shared protocols and open data will be needed.

Autonomous Communities

This scenario places greater focus on services that enable customers to manage and maintain autonomous water systems at building, community or cluster level. Governance and operation of autonomous systems and small scale water networks will be achieved through cooperatives, virtual networks and community platforms.

Survival of the Fittest

This will entail the development of applications to provide customers with real-time data and information about water consumption, availability and pricing. It will require the implementation of differential water pricing and services according to availability of supply, service plans and customer behaviour.

How these scenarios play out will depend on wide range of social, technological, economic, environmental and political trends.





Challenges for water utilities in Australia include meeting future demand for water in a changing climate, managing diverse sources of supply, ensuring the health of waterways and ecological systems, maintaining the affordability of water services and reducing the carbon footprint of urban water supply and use. For urban water utilities, this means making innovation and investment decisions that maximise opportunities to provide services of value, while mitigating future risks and uncertainties.

Personally, I don't believe the future is likely to look like any one of these extreme scenarios. It may lean in one direction but it's probably going to be a combination of a couple of them. Different scenarios might be prevalent in different parts of the city, depending on where the water is available and how open the local council is to collaboration.

Regardless of which scenarios end up being prevalent, there's one constant: the use of technology will have a huge impact on the way we use and manage water.

Currently, most of us just turn on the tap for a drink or a shower without a giving it a second thought.

But as demand for water increases, with growth in city populations, one of the things that will help people manage their water usage is giving them more information about their water bills. This will save them money and help water authorities to reduce overall demand and so will also lower overall costs.

We're moving to a point where technology in individual houses will enable people to have real-time understanding of their water use throughout the day. They'll be able to see how much water is used in each room of the house and at which times, possibly through a smart phone app.

Households will also be able to identify water leaks that they don't currently know they have, which cost both them and the water authorities money.



They'll also be able to see how their water usage will affect their bills.

One other change we may see in the future to help manage demand is for water authorities to consider moving to a point where they utilise the ability to undertake real time monitoring of household use to adopt changes to billing models. For example it would be possible to adopt similar peak and off-peak billing models to those that power companies use. This would enable water authorities to help influence changes in customer behaviour through pricing incentives.

Now that the drought has been broken and the water supply in Australia's cities is secured, at least for the near future, water authorities are under pressure to return dividends to their owners and are focussing on operational expenditure. They want to streamline staff and resourcing and delay capital expenditure where possible.

Technology can help with this.

The information water authorities gain from households and from the wider water system can help them understand how they can minimize their energy costs, consider ways to automate systems and reduce overall operational

expenditure. Real-time monitoring can also help them identify where leaks are in the network – reducing the amount of non-revenue water.

Each city will have different drivers and requirements for water use and running their water supply systems, so what works in Sydney will be slightly different to what's required for Melbourne, Perth or Brisbane.

But these new technologies will help us learn from one another about how to better manage the water. Data from water supply systems and from individual households will give us a better understanding of consumer behaviour and the challenges around how to operate and maintain systems more effectively.

The rate of learning that we have is going to continue to accelerate and that has the potential to continue to fast-track the advancements that are occurring in the water industry.

Ultimately this will assist in delivering better value to the customer and more dividends to the owner. ☺

Daniel Lambert is the Australasia Water Leader at Arup, and has worked closely with water authorities throughout Australia, New Zealand and Asia.

** (While Arup conducted the study in conjunction with Sydney Water, all the views expressed here are Arup's, and do not relate to the future of Sydney Water.)*

Future of Urban Water Infrastructure - Panel Discussion - HotHouse WATER

Images (page 23) Cityscape (http://en.wikipedia.org/wiki/Brisbane#mediaviewer/File:Brisbane_May_2013.jpg) by Lachlan Fearnley (<http://commons.wikimedia.org/wiki/User:EzykronHD>) CC-BY-SA 3.0
 (page 24 top-bottom) Flooding (http://en.wikipedia.org/wiki/100-year_flood#mediaviewer/File:Kaskaskia_Island_1993_flooding.jpg) by (<http://www.defenseimagery.mil/>) CC0
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 Self Sufficient Water Management, Singapore (Source: http://wwf.panda.org/what_we_do/footprint/cities/urban_solutions/themes/water/?204587)
 (page 24-25) Main Outfall Sewer Redevelopment, Melbourne, Vic © Arup

More effective asset management

Shane Day





It's all about having an understanding of what the organisation wants its assets to do.

A systematic approach to asset management can deliver cost savings and a more sustainable business.

It's fair to say that currently managers and operational staff in asset management are often putting out fires – reacting to failures and breakdowns as they occur and fixing problems as they go, be they on fixed assets, such as a bridge or moving assets, such as rolling stock.

This should start changing now that Australia has adopted the new international **standards on asset management**: ISO 55000 provides guidelines for asset management while ISO 55001 sets out the actual requirements for an asset management system.

Asset management is all about ensuring that physical assets can deliver on the business requirements for which they were built – essentially to do what they are meant to do. Taken together, the new standards will provide a framework for asset managers do this more effectively.

The standards take a more holistic view of the role of asset management in an organisation.

They give guidance on how an organisation can integrate its leadership and business values into asset management. They map out how to manage assets all the way up through the organization to achieve a full understanding of how they're performing. This means that if the assets are performing poorly, management understands that straight away and can take action to make sure the assets are fit for purpose and aligned to the business needs.

It's all about having an understanding of what the organisation wants its assets to do. A lot of organisations have very high-level objectives, but they don't always relate to the assets that perform them or these objectives change over time.

In many organizations, there's a breakdown in communication between the operations team on the shop floor who actually carry out the physical maintenance and upper management. The operations team may be keeping the assets available, but not be following the correct procedures, perhaps doing little fixes here and there to keep things going. But over time, typically years, the number of little fixes grows and grows, overtaking the

correct processes and undermining the original business model. When the system fails, it takes management by surprise and incurs huge costs.

Had management and finance been made aware of the looming problem – all the little fixes taking place – they could have come with a better solution or started planning for part of the asset to be replaced.

This is where the new standard comes in.

A Sustainable Approach

Applied effectively, asset management is a window into the future of a business.

The new standard requires integrated reporting so that managers really understand how the asset is performing with regard to its function and against the business requirements. The end result is that the managers get a real understanding of the problems that the maintenance workers are seeing at the coal face and they can free up some resources to make the maintenance more effective.

This makes a lot of financial sense over the life of an asset, because in the long run it's a lot more effective than putting out fires on an ad hoc basis.



This approach dovetails nicely with sustainability – one of Arup’s core values – because there’s less wastage. If managers know how their assets are performing, then they can better deploy their resources and build a sustainable business model.

Asset management isn’t about improving an asset. It’s about getting the performance and meeting the business objectives for what it was designed for.

Nonetheless, when the business needs change, asset management also has a role to play. The better the assets are understood, the more easily they can be changed or adapted while keeping disruption or shutdowns to a minimum. Managers have time to make adjustments to fill business requirements that might change over time because they have a full understanding of the assets.

Finally, the new standards will also play a crucial role at the tender and construction phase of a project.

Until now when a government or a public private partnership has been scoping a project, it has been very difficult to get a clear view on how that asset will be managed over its lifetime. This can make it very hard to assess the maintenance components

of bids and can require considerable time and expertise to review this. Even then, it was a long way from being a precise science.

The new standards change all that. They help project owners understand how an asset is going to be looked after 30 years into the future.

This is important. The upfront costs of major projects are the ones that grab the headlines, but the cost of maintaining an asset over its lifetime are typically many times larger.

The new standards play another important role in the construction stage of a project. They ensure that the people who build the asset comply with the asset management standards before they hand it over to those who will maintain it and look after it, making asset management more effective.

The Journey to Excellence

The new ISO standards came into effect in Australia last November, and a lot of local organisations are playing catch up.

Many are doing a gap analysis – getting outside organisations, such as Arup, to review their maintenance and management of their assets and give it an objective score. The organisation then has a competency and compliance record against which it can improve its asset management.

To me, improving asset management is a real no brainer. If you look after your assets properly then you know you’re going to get a return on that investment, with fewer failures and lower costs.

Organisations are assessed on their asset management practices with four different ratings: ad hoc, aware, achieving, and operational excellence. Adopting the new standards will help Australian asset owners and operators move further up the scale towards operational excellence, with the ensuing cost savings and sustainability benefits. *Q*

Shane Day works in Arup’s Sydney-based asset management practice. He has two decades experience, and has developed a wide range of operational and maintenance solutions in the design and support phases of several rolling stock projects.

Images (page 30): Brisbane Airport Link, Qld © PBAJV (page 31 clockwise from left): Regional Rail Link, Vic © Regional Rail Link Media Library, Wynyard Station, NSW © Arup, (page 32): Port Botany, NSW © Arup

A vision of the future of rail

Arup's Future of Rail 2050 report unveils a vision of the future of rail travel in light of trends such as urban population growth, climate change and emerging technologies.

It foresees:

- Predictive maintenance of rail lines by robot drones
- Driverless trains travelling safely at high speed

- Freight delivered automatically to its destination

- Ticketless travel through smart technology

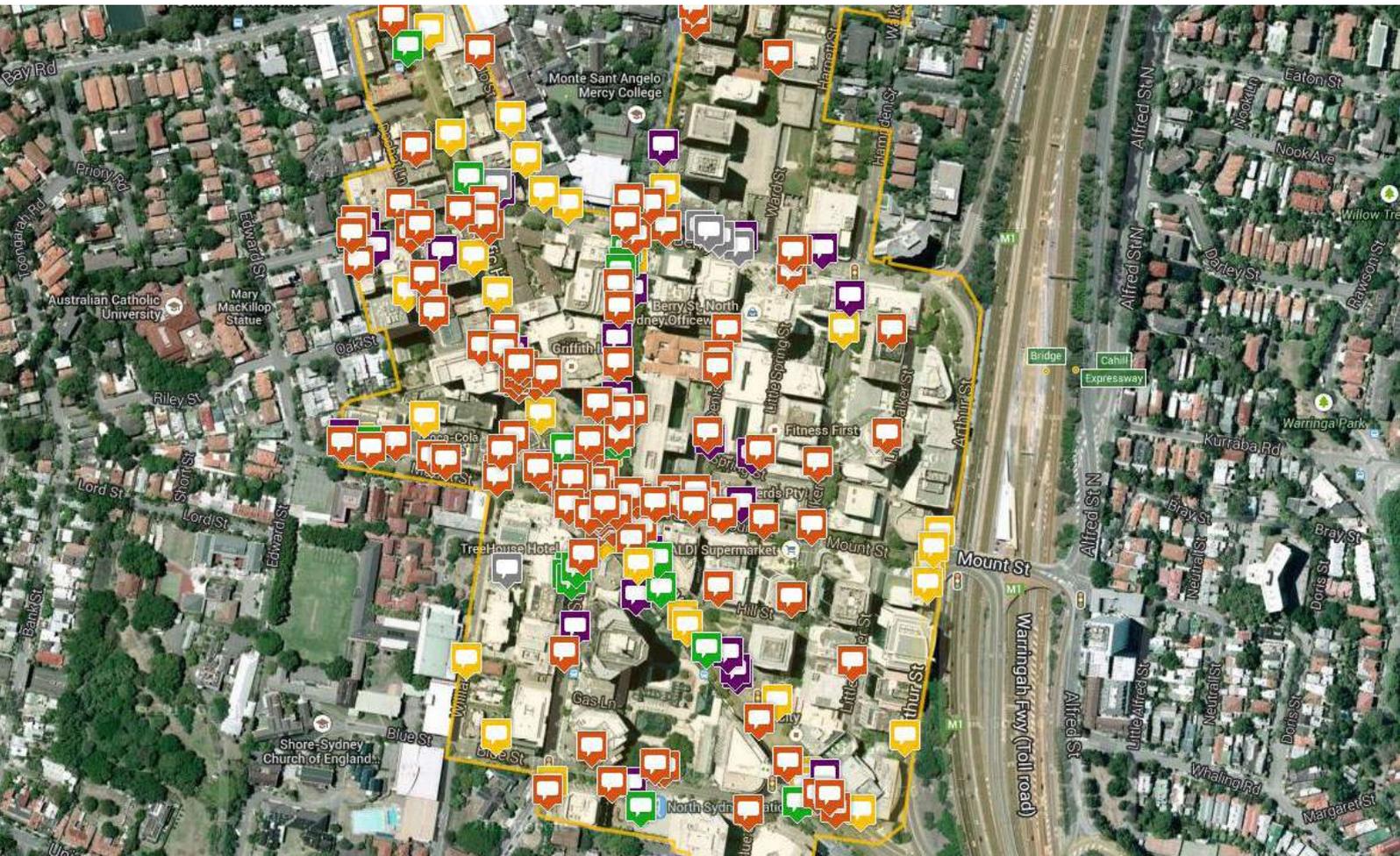
Colin Stewart, Arup's Global Rail Leader, predicts a bright future: *"By rapidly developing technology and taking bold steps to overcome capacity and cost challenges, the rail renaissance can deliver a future where it is the backbone of our travel system."*

Arup used developments from current rail projects the firm is leading around the world, as well as insight from the Arup Foresight + Research + Innovation team and global contributors, to inform the futuristic predictions outlined in the report.

Future of Rail 2050



New Delhi Railway Station Redevelopment



Marissa Powell

I'm a member of the Integrated Environments Group in Arup's Brisbane office. In my role as a social and engagement specialist, I work with stakeholders and communities during the planning and implementation of built environment projects. Some of my projects land in places with an established community, in some places people have no connection to each other

and some projects turn out to be the glue which actually brings a community together.

I'm interested in how we 'build' community into new and established places and how we maintain or get people interacting with each other in a more meaningful way within the places and spaces we design.

Planning: technology improves engagement

Marissa Powell  

Engaging with stakeholders and the community is essential for spatial planning on any scale. It's a process we can improve by using technology to gather and map people's feedback.

I've spent much of my working life talking to people about built environment projects. As an engagement specialist I'm always asking myself - how can we **better engage with communities about projects that affect them?** How do I make sure that the technical team takes this input into consideration? And as a consultant, how do I get all this to fit within the project's budget?

Over the years I've seen that people who participate in stakeholder and community engagement activities generally fit into one of three categories – retirees and people with time on their hands, people who stand to lose something of value to them and people who are passionate about a cause or issue. They are the ultra-motivated, the people who turn up to meetings and displays and, unfortunately, the people who skew our engagement data as they are not representative of the broader population.

The rest think “I should get involved but I'm too busy” or “that's kind of interesting, but not enough to make me do anything”. Maybe they planned to get involved but forgot or maybe they're oblivious to the entire situation. These are the people that we're missing through traditional engagement approaches, yet they are the most important if we're to ensure more representative input is fed into our planning processes.

To engage these people we have to understand how to make it easy for them to participate in the discussion – especially when they are usually time poor, they want to give and get information quickly and they now carry their digital life with them wherever they go. I've also found that it's time consuming, and often difficult, to translate rafts of qualitative data gained through engagement processes into something meaningful that we can use to inform planning decisions.

To address these two issues I've been working with a team of software developers and spatial mapping specialists for the past few years to develop an online engagement tool that allows people to provide meaningful input into spatial planning projects. **Collaborative Community Map** allows people to participate in

engagement activities and add their comments to the map from their own computers and devices, rather than having to set aside time to come to a workshop or meeting.

Online engagement doesn't replace traditional face-to-face methods; some stakeholders and communities will still want to be involved in this way. But it does open up your engagement programme to those you would otherwise have missed. For example, I went to a youth event (a skate competition) in a town where we are doing engagement work armed with an iPad and Collaborative Map. The kids who would usually not say anything in an engagement process were using the tool to input their ideas for their town.

By gathering spatially located data, technology can help project teams map constraints and concerns associated with planning and design proposals. These can then be drawn into a GIS environment for further analysis and visualisation.

This approach is helping me to do my job better as more people are getting involved in engagement activities and I'm bringing better and more useable data back to my technical teams. 

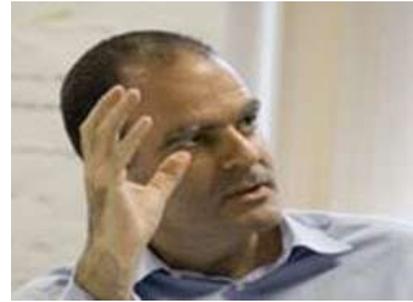
Continue the conversation at [Arup Thoughts](#).

Image: North Sydney Council Traffic and Pedestrian Management Study. Source: collaborativemap.org © Arup

Interchanges: more than just travel

Leszek Dobrovolsky





Leszek Dobrovolsky

I lead the interchange design consultancy for Arup; designing integrated interchanges and exploring development opportunities around interchanges.

I am passionate about the opportunities that connecting people to places through transport offers. My particular skill is in enabling clients to realise a vision which maximises the significant potential of transport environments.

My experience ranges from some of the largest stations and metros in the world – such as Stratford International Station, a key part of the 2012 London Olympics, to the smallest element of product design, such as transport shelters in the global south.

I believe the design of integrated interchanges creates environments of spatially delightful and sustainable activities at the node, as well as fertile urban development and regeneration opportunities in the surrounding areas.

Data growth, flexible working, and changing expectations are shaping new travel habits. Now interchange design must respond.

It used to be thought that the rise of data and the mobile internet would cut the amount people travel. It hasn't, although it has changed travel patterns and it's also enabling us all to work more flexibly.

Interchanges need to respond to this. They need to become places you work at, rather than just places that help you get to work. They need to offer facilities that help people with elements of their lives beyond travel – whether that's a crèche, a bicycle repair shop, a community hall or pay-as-you-go office space.

I've been part of an Arup team working with [Metro de Santiago](#) in Chile, the busiest such system in Latin

America, to help critically rethink what the metro is for and what should happen there. How can it provide more amenities for travellers?

[Park Station](#) in Johannesburg is Africa's busiest interchange with a complex web of coach, taxi, pedestrian and rail connections. It's also a place where the informal and formal economies overlap, and Arup is helping operators and property owners look at how the interchange can help informal sellers move into the formal economy.

This is what interchange design involves today. It can no longer be a single-discipline undertaking, but a trans-disciplinary design effort involving a vast range of skills and underpinned by a robust and sustainable business case.

This will require a new way of thinking about transport. In the future, interchange design will hinge on in-depth thinking about what happens

within a series of buildings that make up the interchange. And buildings themselves will need to become increasingly adaptable to accommodate changing patterns of use.

Maybe this means using new technologies and materials that can be easily reconfigured. It certainly means that countries like the UK, which have ageing infrastructure, face a big challenge. It's a challenge that requires a radical design response.

People's expectations of travel have changed fundamentally. It's time for interchange design to be more than just travel! ☺

Continue the conversation at [Arup Thoughts](#).

Image: Cityringen, Copenhagen © Arup



Future of Highways

Future highways will be made from self-healing, glow-in-the-dark materials and will be governed by sophisticated technologies that communicate with cars, road infrastructure and GPS systems.

The Future of Highways report looks at the implications of trends up to 2050 and considers the consequences of themes including rapid urbanisation. Up to seventy five percent of the global population will be city dwellers by 2050. The Future of Highways considers why this rise in the urban population means we

will need to substantially increase the capacity for individual mobility and freight transport. The report also considers how climate change, resource depletion and changes in human behaviour will shape our roads in the future

“This report and thinking about the evolution of the roads and road infrastructure allows us to talk about design principles that will lead us into the future.”

— Ben Snitzerling, Highways Business Leader, Australasia, Arup

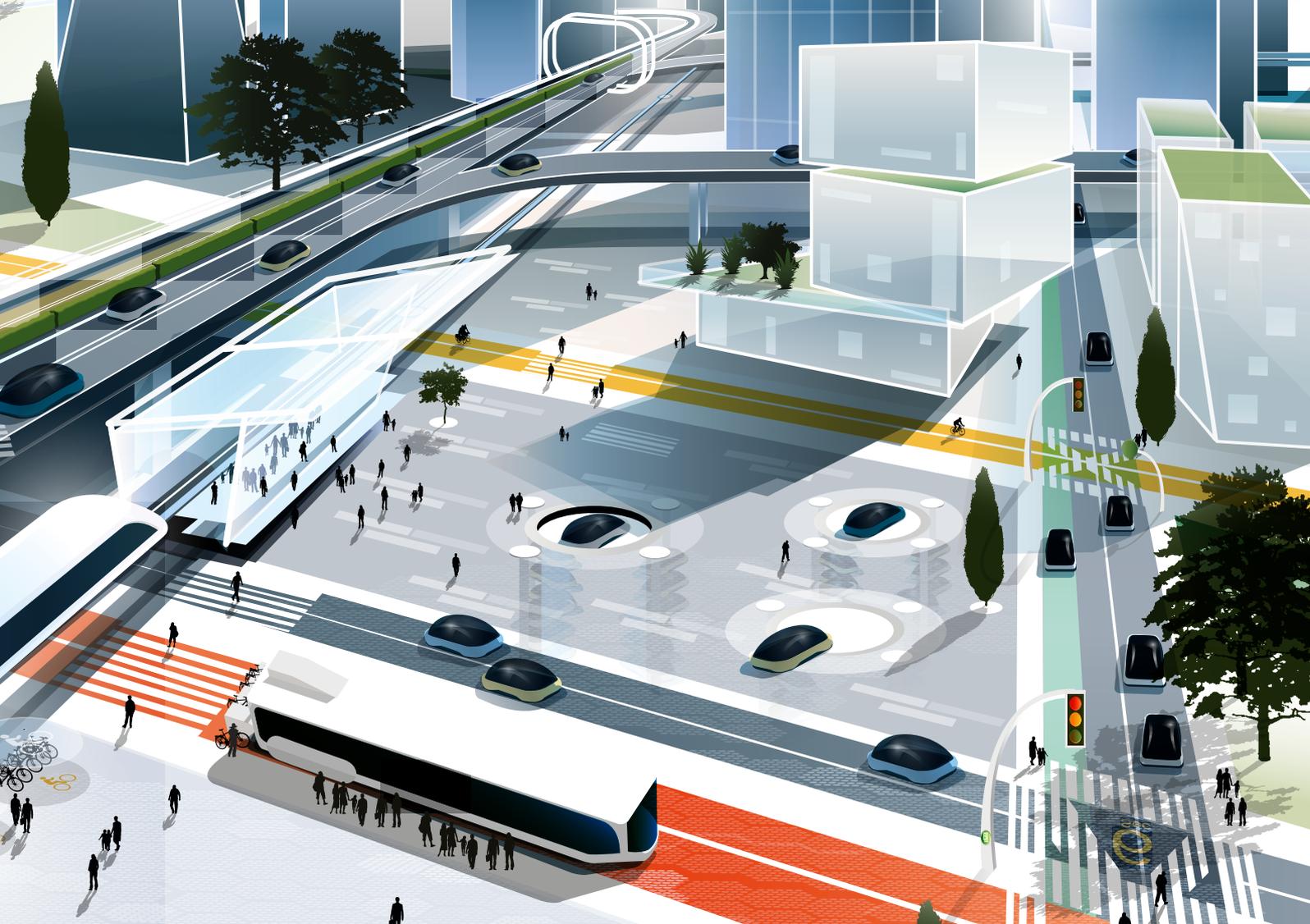
Infrastructure

With a vast increase in the number of road users, minimising the impact and frequency of maintenance work will be critical.

The progress anticipated in the development of materials such as self-healing concrete – which produces

bacteria to fill cracks when concrete gets damaged – could significantly reduce the cost of a structure, while creating a more resilient and sustainable infrastructure. These savings could have a considerable environmental impact due to the fact that seven percent of the world’s CO₂ emissions are currently due to concrete production.

As well as being self-healing, the report envisions that surfaces could be replaced with advanced solar panels that would generate clean and renewable power, and wirelessly charge electric cars as they are driving on the roads or are parked. The panels would also contain LED lighting and heating elements to melt snow. Temperature-sensitive paint on the roads will generate giant snowflake-shaped warnings to indicate a drop in temperature and icy conditions.



“Roads and road infrastructure are evolving, and innovative thinking will allow us to ensure we deliver safer, more sustainable, and accessible transport systems for generations to come.”

— Ben Snitzerling, Highways Business Leader, Australasia, Arup

Vehicles and traffic

As well as highwahas evolving, the report foresees that patterns of ownership will change in the coming years, with commuters more likely to purchase access to a vehicle rather than the vehicle itself. While the number of motorised vehicles on our roads is expected to increase by three percent annually until 2030 - up to two billion - the use of non-motorised transport such as bikes and walking is also due to rise in popularity. Cities worldwide, such as London, New York, Copenhagen and Bogota, have already recognised this trend and have started to implement strategies

to reduce congestion and support the health of their citizens through various cycle and walking schemes.

Electric cars are anticipated to become commonplace on the roads of the future as developments in material science will dramatically improve the performance of batteries and the potential for increased electricity storage. Fully-automated navigation systems will also enable roads to be populated by driverless cars which could change the design and operation of highways, and provide safety and environmental benefits.

The report also suggests a number of ways in which we might respond to the increasing volume of traffic on our roads. Vehicles will become increasingly ‘intelligent’ and ‘self-aware’: a combination of the connected vehicle and the Internet of Things will enable vehicles to broadcast and receive information on

traffic, speed, weather and potential safety hazards. As a result, cars will be able to travel closer together and react more quickly to variables around them. This will open the market to people previously unable to operate vehicles such as the elderly or disabled.

“Intelligent traffic and control systems will make our roads safer and more sustainable. By communicating with traffic signals, traffic cameras and GPS systems, these solutions will help make our roads a safer place to travel on. Driver stress caused as a result of heavy traffic and delays will be a thing of the past, as drivers will receive customised information from commercial travel services to make their journey as easy and free-flowing as possible.”

— Tim Gammons, Director, Intelligent Transport Systems, Arup

Download the report [here](#). 

Image: © Rob House

Reigniting civic space

Nille Juul-Sorensen

Stations have increasingly become transitional, functional spaces; neglected as places for us to take delight in. I think we need to revive the vitality and vigour they once brought to the everyday lives of their communities.

Stations of the past were at the heart of civic life, alongside libraries, post offices and even power stations. Learning from history can help us to create more vibrant, useful and integrated station spaces that have the community at their core. Without the bustle of bodies stepping onto the platform, rushing to catch the next departing train, greeting loved ones or waving them goodbye, our stations would not only be soul-less but purpose-less. Broadening our view to see them as nodes of urban redevelopment will help us to avoid creating a 'one size fits all' solution.

Designers need to look deeper into our communities to encourage more creativity, unlocking tailored and forward-thinking forms of regeneration. People sit at the very heart of our cities, and their stations,

which is why we need to engage local communities in the renewal of these spaces, to encourage collaborative and bespoke urban transformation. Like a person, each city and each station has its own personality and we need to create innovative new uses for these buildings to remain at the heart of the communities they serve. Stations need to be re-created, to work for each individual space and to optimise the value they create as part of the wider city. And it's not just large city stations that need to be reignited, we need to give smaller stations more attention too.

Designers need to work with the people who use these civic spaces to find out not only what they really want, but what they need. An interesting example of this is the insertion of a library into the facilities of a Danish swimming pool. What started as a clever way to engage adults with children in swimming lessons became an opportunity for those children to discover and embrace literature.

Another example of this innovative thinking is Daan Roosegaarde's Smart Highway perspective on 'hacking'

roads instead of vehicles to digitally monitor and adapt to light and weather. This reflects a new way of thinking yet to have been exhibited in the regeneration of communal spaces and particularly in stations.

A Copenhagen power station which hosts a ski slope in the winter and transforms to a skate park in the summer, is another great example of how we can think smarter about reigniting urban public space. This building has been transformed from a dead, uninhabited power hub into an active and central part of the local community.

Let's not lose our stations from the heart of civic life but restore them with innovation and excitement. Not only do we need to consult with the community, but we need to think outside our traditional infrastructural boundaries. If we don't create spaces people want to enjoy, what role will they play in society? 

Continue the conversation at [Arup Thoughts](#).

Image: Kings Cross Station, UK © Hufton + Crow
Video: Cities and Stations - Nille Juul-Sorensen © Arup



Nille Juul-Sorensen

I have worked for Arup since 2004. I rejoined the firm in summer 2014 after a 3-year sabbatical as the CEO of The Danish Design Council.

A trained architect and product designer, I have been trained to work on objects like metro stations and design objects. My interest for the last few years has been in looking at why we design what we do and how we can see this as part of a system.

Thanks to technology, we can now gain much more qualified buy-in from stakeholders, local communities and individuals. So I believe we now need to focus not just on designing quality objects - be they buildings or products – but also the system that surrounds them.

To give meaning to our designs, we need involvement on all levels from the people around us – we need to add value to the broader community. To me, we shape a better world through collaboration and not through individual objects.



Street lighting must get smarter

Leni Schwendinger



Leni Schwendinger

I lead the nighttime design/global lighting urbanist initiative in Arup's lighting team developing aesthetic illumination practices for complex urban settings.

I have over 20 years of experience creating illuminated environments, products and programs for public spaces. One of my proudest achievements has been planning and designing implementation projects. For example, the 82nd Street Partnership Lighting Strategy which was a roadmap for illumination and community-building. This work developed creative concepts for a diverse neighbourhood in New York City blighted by an elevated train overpass – all informed by active community engagement.

My work is shared through speaking engagements and advisory services. I have lectured and taught widely throughout the United States, Latin America, Europe and Japan.

I am a Fellow of the Forum for Urban Design and a member of the International Association of Lighting Designers.

Turning off street lights at an arbitrary time such as midnight may appeal to city leaders. After all, doesn't it save both money and energy? I don't believe it's this simple.

Instead, I think the rise and fall of public lighting in a city should be determined by the activity on its streets and pavements. This more nuanced approach would see light provided when it's needed.

For example, if all the restaurants and shops in an area are still open at 8pm, their lights may be enough to illuminate the street. So public lighting may not need to be on at this time, at least not at full power.

But at 11pm, say, there may be shift workers going home or clubbers going



out. With shops and restaurants now closed, there would be no private light spilling onto the street and public lighting should be on to help people travel safely and securely.

Some cities around the world are experimenting with this approach. Glasgow is trialling ‘[intuitive](#)’ [street lighting](#) that responds to factors such as noise. I think cities need to make use of new technology in this way. But they also need to engage with the issue more fundamentally.

I’d argue that cities need lighting committees in the same way they have planning committees. These would build an understanding of an area, including predicted, planned development, of how people will use the public space and therefore how it should be lit.

I also think it’s essential to [involve local communities](#) in this process. In Cartagena, Colombia, Arup is researching how to create high-quality night-time public spaces. As part of the project, districts are invited to explore their after-dark hours, highlight dark spots and gaps – those that are unsafe or unwelcoming – and influence design decisions.

Ultimately, night-time is essentially different from daytime. So it deserves its own design approach, and thinking creatively and smarter about street lighting is a vital part of this. [📍](#)

Continue the conversation at [Arup Thoughts](#).

Images (L-R): Berlin Kantstrasse, Germany © Hans Peter Kuhn, Webb Bridge, Vic © Shannon McGrath

Watch the film to find out more about how the use of light can transform urban spaces at night.

Lighting experts from different disciplines come together to discuss the importance of lighting, and what needs to be considered when planning our cities.



Dr Chau Chak Wing Building

The first building in Australia designed by internationally renowned architect Frank Gehry, the **Dr Chau Chak Wing Building** at the University of Technology, Sydney (UTS), has officially opened.

The Dr Chau Chak Wing Building, designed by architects Gehry Partners with collaborating partners including Arup, has instantly become a new landmark building in Sydney and is a fusion of architectural and engineering vision.

Arup has previously worked with Gehry Partners globally on projects including the Guggenheim Abu Dhabi, the Casassa Building at Loyola Law School in Los Angeles, and **Maggie's Centres in both Hong Kong** and Scotland.

Inspired by a tree house, the stacked, undulating design of the building features two major façade materials. The glazed western face blends into the Sydney CBD behind the building and the curved brick exterior reflects its industrial Ultimo location.

As lead façade consultant, Arup informed the shape, materiality and construction methodology of all three of the façade elements – the brick,

glazed face and glass window boxes. The geometrical complexity of the brick façade required extensive 3D modelling and experimentation with various means of constructing to make possible. Arup façade engineers worked closely with the sub-contractors to realise an innovative and practical solution.

The irregularity of the brick is mimicked by the building's interior, as each of the floors is distinct in shape and several feature large bulbous cantilevers. As designed by Gehry to support UTS' vision, the central spaces are free of columns to create open collaborative spaces for students and staff; these are punctuated by sloping columns around the building's perimeter. Arup structural engineers resolved the complexity of this form to ensure structural stability.

“A highly iterative approach to the design was required to marry the sculptural form and internal functionality, whilst realising its unique features including the undulating brick façade and highly faceted glaze façade. The brick façade and structure of the building needed to meet and move in the right way and the glazed façade features over 400 different angled glass panes. The collaborative approach in design and construction and the use of cutting

edge technology ensured that delivery proceeded with minimal disruption which was a triumph on such an innovative building.”

— Arup Project Director
Peter Hartigan

Arup also assisted the delivery of the three-level, oval class room, which features the world's largest spanning timber/concrete composite slab construction and the first of its kind in Australia.

The building is also one of Sydney's greenest education buildings and has received the 5 Star Green Star – Education Design v1 rating from the Green Building Council of Australia.

The Dr Chau Chak Wing building is part of a larger masterplan for UTS that is designed to ensure it remains at the forefront of tertiary education and research, and is expected to fundamentally change the way teaching, learning and research are delivered at the University. 

Introducing the Frank Gehry designed Dr Chau Chak Wing Building, now home to UTS Business School.

Image: Dr Chau Chak Wing Building, Sydney, NSW © Arup

Video: Introducing the Frank Gehry designed Dr Chau Chak Wing Building, now home to UTS Business School © University of Technology, Sydney



Singapore Sports Hub

Arup's innovative design for the world-class 55,000-seat national stadium is a model for future sustainable stadium design. From the outset the design ambition was to create a sustainable, fully integrated sports, entertainment and lifestyle hub, accessible to all.

Arup was enlisted to lead the architectural and engineering design of the Singapore Sports Hub, conceived as part of the greater [Marina Bay Masterplan](#) to reposition Singapore as a great place to work, live and play. The appointment followed expertise demonstrated by the firm in creating international landmark stadiums like the [Beijing National Stadium](#) (Bird's Nest), the [Allianz Arena](#) and the City of Manchester Stadium.

Addressing the issue of spectator comfort in the tropics, Arup designed an ultra-thin dome roof structure with a movable roof that extends over the pitch. The clever design provides shade during events and an energy-efficient spectator cooling system that delivers cooled air to every seat in the stadium. To maximise the stadium's utility, an innovative moving tier design allows the venue to accommodate a wide sporting calendar of events from cricket to football and the annual National Day Parade.

Design versatility

Versatility is a key component of the stadium design. By integrating moving tiers, palletised turf modules and a fully closing roof, the stadium can accommodate a wide calendar of sporting events like football, athletics and cricket as well as other events such as the National Day Parade.

The focus has been to achieve this flexibility within the design without compromising on the proximity and quality of view for spectators at a football match. The stadium will be the first in the world to combine the sports of football, athletics and cricket in the same arena.

An engineering feat

The National Stadium will be one of the largest in the world. Clive Lewis, design leader for the project says, "We designed the stadium as an elegant dome spanning 310m – that's close to four A380 airplanes parked wing to wing. Not only is it wide, the ultra-thin shell roof structure is also very efficient and uses minimum materials for construction."

Comfort in the tropics

The new National Stadium is a model for tropical climate design.



It features an innovative energy-efficient spectator cooling system that delivers cooled air to every seat in the stadium. These pockets of cooled air will reduce energy use significantly, compared to a more conventional overhead cooling system.

The Sports Hub is Arup's latest landmark project in Singapore following the successful completion of the necklace of attractions around Marina Bay which include the [Singapore Flyer](#), the [Helix Bridge](#) and the [Marina Bay Sands](#)® integrated resort.

When completed in 2014, the Sports Hub will reinforce Singapore's position as a major international sports destination, following the success of events like the F1 and the Youth Olympic Games. 

See more of our [Singapore projects](#).

Image: Singapore Sports Hub, Singapore © Arup



Singapore Sports Hub timelapse

Sydney Cricket Ground

The Sydney Cricket Ground masterplan is transforming this historic stadium, reaffirming its role as a major sports and entertainment complex while celebrating its tradition and heritage. Stage one of the redevelopment was completed in 2008 with the opening of the Victor Trumper Stand. Stage two is replacement of the MA Noble, Don Bradman and Dally Messenger Stands with a new AU\$186m pavilion.

On a site constrained by Moore Park, Fox Studios, the adjacent Sydney Football Stadium and the historic Noble Stand Clock Tower, it was critical to minimise construction footprint and impact. Arup's design involvement for stage one enabled us to contribute to planning of stage two from the outset.

Integrated facilities

The Northern Stand pavilion welcomes guests into a world-class facility with amenities including dining, bars, a microbrewery, retail, corporate, media and player facilities.



A double-height, clear span 700 seat dining room featuring a full-height glazed façade provides unobstructed views to both the members lawn and the city.

A concrete structure with steel seating terraces over five levels, the new stand is covered by a curved geometric 'floating' roof. Supported by just three columns, the roof structure allows unobstructed views of the field, 85 per cent undercover seating and improves spectator comfort.

Fire safety for such a major grandstand and pavilion was a critical consideration. Mitigating fire risks through close collaboration on structural design helped ensure safety and code requirements were met by the project deadlines. ☞

See more of our [sports stadium projects](#).

Image: Sydney Cricket Ground Noble and Bradman Stands, Sydney, NSW © Carl Drury

Ngeringa Concert Hall

The Ngeringa Arts Concert Hall, due for completion in August this year, is a unique and boutique performance space located at the Ngeringa Arts Cultural Centre in Mount Barker, South Australia. It will foster Ngeringa Arts' aim of creating opportunities for musicians to perform, in addition to having access to some of the world's finest string instruments. Arup has led the acoustic design for the space having worked closely with client, Ulrike Klein and architect Anton Johnson, in order to achieve exemplary acoustics for chamber music while preserving the intimate scale and aesthetic character of the architectural scheme. Critical to the design has been providing the

same aural experience as a traditional rectangular hall, including rich lateral sound reflections, spaciousness combined with superb clarity, intertwined with the visual intimacy of a circular hall: matching acoustics to visual quality.

The design process included auralisation (acoustic rendering) workshops with the client and architect, in the Arup SoundLab, acoustic computer modelling and design of sound scattering finishes. The near circular room shape and domed roof provided significant acoustic challenges, as well as the glazed walls behind the performers. The resulting acoustic design features

mean the sound created will be like a "rectangular hall sound" but in a circular space. Acoustic elements are incorporated seamlessly into the building structure itself – including the architect's spiralling reciprocal-frame roof design and the 'wavy wall' modulations cast into the structural rammed-earth walls. The acoustic elements of the design have been developed in close collaboration with the architect so that the "architecture is the acoustics and the acoustics is the architecture." ☞

One Central Park

One Central Park blends artistic vision, the natural world and public benefit into one striking mixed-use building.

Sitting alongside Sydney's CBD, it stands as a green column distinct from the surrounding towers and warehouses. Architecturally sculpted, the irregularities of the building's balconies, use of glass and enormous cantilever create an impressive aesthetic, even before considering the thousands of flowering plants that line the exterior.

The strategic use of greenery is significant however; One Central Park was named the **Best Tall Building – Worldwide 2014** largely due to the innovative and sustainable approach these plants represent. Arup provided a multi-disciplinary service including mechanical, electrical, fire and public health engineering, lighting design, waste and vertical transportation consultation. Our environmentally sustainable design provision contributed to the strategy for the entire precinct.

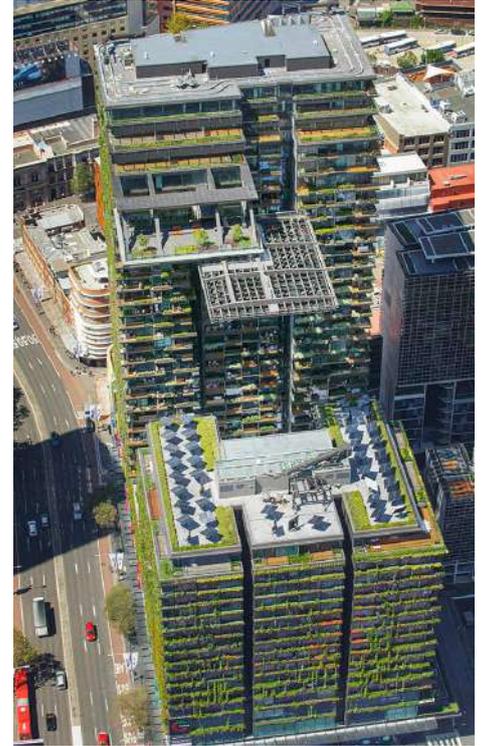
Community sustainability

One Central Park approaches sustainability broadly, attracting 5 Star Green Star ratings for its retail and residential sections while aiming to provide a wider, public benefit. The essence of the engineering and architecture revolves around amenity; the creation of spaces and environments which people can embrace, emphasised by the focus on public land and abundance of plant life.

The sustainability framework was developed by Arup in collaboration with WSP Lincolne Scott. A central tri-generation plant provides low carbon electricity to the complex and its properties. Enhancing this, each apartment is fitted with smart metering screens which provide interactive, real-time monitoring of electrical, gas and water consumption, enabling them to better track and moderate usage. Arup performed thermal analysis on each apartment to inform the integration of individual façades, their articulation and materiality. These allow for a reduction in mechanical services for the building despite an improvement in occupant comfort.

The heliostat maximises beneficial use of the sun, providing natural light into the park and retail recess which would otherwise be lost in the building's shadow. Arup technicians contributed daylight modelling to inform this feature. ☺

Image: Aerial of One Central Park, Sydney, NSW © John Gollings Courtesy of Frasers Property and Sekisui House





50 Martin Place

50 Martin Place is an ambitious blend of heritage preservation and forward thinking commercial property design. The site, a landmark of Sydney's CBD, was chosen by Macquarie Group as a commitment to the area's historic financial district.

The building's external aesthetic and internal features contrast sharply. From the street, the heritage qualities remain almost completely unchanged, except for the glimpse of the magnificent new glass dome which crowns the structure. Within, the building possesses the latest in sustainable solutions and workplace environments.

World class sustainability

The sustainable performance of 50 Martin Place required careful balancing

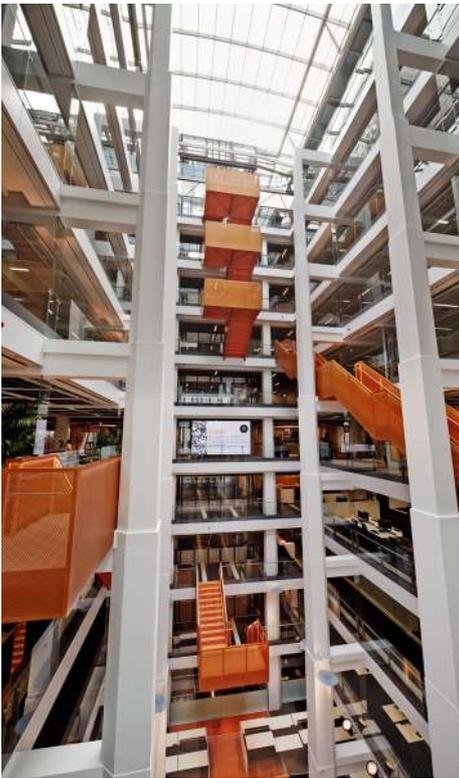


Felicity
Briody  

Senior Project Manager,
Management Group, Arup

Co-Founder and President,
Power of Engineering

Founding Director, Machinam



to conform to heritage standards. To achieve this, Arup retrofitted the building fabric with unobtrusive, yet highly efficient building services. The air conditioning system is a key component and features a number of bespoke solutions. Cooling units are integrated into trading desks and underfloor displacement delivers fresh air drawn from a raised access floor in combination with chilled beams on other levels. These remove the need for bulky ducting, accentuating the interior architectural features of the original building. An onsite treatment facility captures and processes storm water.

Modern functionality

Open and collaborative, the building conveys modernity through its workplaces and interconnected spaces. A full-height open-edged atrium was

cut from the existing light well to emphasise internal space and allow interaction between occupants. From above, the building connects to the outside world through the glass dome, providing ample daylight through the atrium void. The air conditioning system utilises the atrium to draw fresh air across the floors and up through the void acting like a giant lung within the building.

50 Martin Place is an example of intelligent reuse. It demonstrates that our historic properties can be retrofitted in a way that is sympathetic to their heritage status, yet still deliver world-class functionality and performance. 

Image: 50 Martin Place, Sydney, NSW © Peter Bennetts

Felicity co-founded **Power of Engineering** in 2012 after realizing the lack of diversity in engineering and considering the role and impact engineering projects have on the community. Since then, the organization has inspired over 2,500 year 9 and 10 high school students across Australia about diverse, creative and innovative engineering careers.

Felicity has been named by the Australian Financial Review and Westpac Bank in the 100 Women of Influence, received the Queensland young leader award from the National Association of Women in Construction and was selected as a Young Social Pioneer with the Foundation for Young Australians. Felicity is a Founding Director of **Machinam** which is creating alternatives to traditional textbooks with a vision to increase diversity and innovation in STEM.

Machinam uses the latest in app technology and a real world approach to framing problems to help students to connect what they are learning in class to their real life and future career pathways. Felicity has a background in Civil Engineering and works as a Senior Project Manager with Arup in their Sydney office. Felicity is passionate about engineers creating an innovative and inclusive world. 

Females powering engineering

Felicity speaking at **TEDxQUTChange**. *“All you need is to be passionate, imagine what is possible and get out there and share your ideas. You never know what will happen in the conversation or where it will lead.”*



Simon Barnes



Façade Design Leader, Arup

We are delighted to announce Simon Barnes, has joined Arup as Façade Design Leader in the Melbourne Facades team. Simon brings with him over 18 years of multidisciplinary and architectural design experience having worked previously with BG&E Façade Consultants and Arup in London.

Simon has been involved with many high profile projects both locally and overseas including phase 1 of the Royal Children’s Hospital Melbourne redevelopment, 171 Collins Street Melbourne and a new premium residential tower at 35 Spring Street. He led the façade design team on the \$2.0bn Fiona Stanley Hospital in

Western Australia and spearheaded the façade review role for the technically complex New Royal Adelaide Hospital.

Internationally, Simon has been involved with a number of high profile projects including the award-winning Kings Place, home to London’s The Guardian newspaper, and the Zaragoza Bridge Pavilion by Zaha Hadid in Spain. Simon’s work spans across the healthcare, education, commercial and residential markets.

“Simon brings to Arup an impressive portfolio of design work and is a valuable addition to our specialist Facades team in Melbourne. In

addition to working with clients in Victoria and South Australia, Simon will also liaise closely with other Arup offices around the region and globally, harnessing the best of our thinking to realise the exemplar projects of the future for our clients.”

— Joseph Correnza, Southern Regional Office Leader.

In addition to his portfolio of project work, Simon regularly guest lectures and presents to industry on design and manufacturing trends, and has a particular interest in the area of sustainable cities and patterns of future development. ☺

Brian Smith



Public Transport Planning Specialist, Arup

Brian Smith, Public Transport Planning Specialist, has joined Arup to enhance our integrated transport planning capability. With over 35 years’ of experience in the planning, management, and operation of public transport systems.

He brings a high level of technical experience that spans major multi-modal transport strategies, public transport policy and the design and operations of transport interchanges.

At a project level, this has seen the delivery of transport elements including light rail transit, bus priority, urban design, passenger transport information, electronic ticketing and fares, bicycle planning and traffic and parking impact assessment. He has led significant city shaping projects including Sydney Rapid Transit Bus Strategy, Sydney Airport Pedestrian Experience, North West Rail Link and the NSW Commuter Car Parking Implementation Plan.

As a respected industry leader, Brian has written extensively on transport interchanges and terminal design. He is passionate about delivering transport solutions that foster connectivity and accessibility within cities, and will continue to lead the industry in solving seemingly intractable transport problems while with Arup. ☺



Joan Ko

Senior Sustainability
Consultant, Environmental
Group, Arup

Co-Founder and President,
Power of Engineering

Founding Director, Machinam

Joan grew up in Melbourne, studied in the UK as a Gates Scholar, worked in London, then came back home to work as a sustainability consultant for property development, infrastructure, planning and government.

Joan is an environmental engineer who focuses on sustainability issues related to urban development. Her skills include carbon footprinting, masterplanning and delivery models for precinct-scale infrastructure. She has been embedded as a sustainability specialist with the Victorian State government developer, a major rail infrastructure construction project, the UK Highways Agency and Monash University.

With skills in mediation and negotiation, Joan has a particular interest in change management, risk communication, and workshop

facilitation. She has authored papers about environmental mediation, socio-technical change in the construction industry and the impact of highways on communities. Joan is a Teaching Fellow with the Department of Civil Engineering at Monash University.

On Wednesday 18 February 2015, the fifth forum in the Shaping our City series focused on the Conversations that shape Melbourne. Joan moderated a lively discussion from the panel of five leading voices from industry, journalism, NGOs, and the arts. 

Joan moderated a lively discussion from the panel of five leading voices from industry, journalism, NGOs, and the arts for the [Shaping our City](#) event in Melbourne earlier this year.

Support for Vanuatu in Response to Cyclone PAM

Funds are urgently required to provide emergency supplies and send more experts into the area to assist with the response. We need your help to spread the word. Please help us to make a difference by donating money and sharing the donation links with your networks. You will find links to humanitarian organisations providing support, read more about the crisis and what we are doing by going to the [Arup Community Engagement](#) site. 

Image: © UNICEF Pacific (<https://www.flickr.com/photos/69583224@N05/16654814278/in/set-72157651394799851>)



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