

ISSUE 07 · 2017

# Skyline

Insights into planning  
spaces around us

## Work/learn spaces of tomorrow

A look at Jurong Lake District and  
SIT Punggol campus



URA Chairman on  
planning for uncertainty

4 disruptors  
rethink spaces

Urban activism  
on the rise

 URBAN  
REDEVELOPMENT  
AUTHORITY



Australian architect and urban planner Katherine Murray educates local youths about the city during her first major urban design workshop, it was part of the Urban Planning Festival held in March 2017. She tells us why we need to engage youths on page 38.

## Contents

### THINKING ALOUD

#### 03 Ideas and imagination

### SPOTLIGHT

#### 04 In short

#### 05 More reasons to cycle

Property developers respond to walking and cycling plan

#### 06 New recipe for the future?

Luke Williams suggests how disruptive thinking can be applied in rethinking Singapore's cityscape

#### 09 Planning for uncertainty

URA Chairman Peter Ho on why imagination and partnerships are key for our future

### NEIGHBOURHOODS

#### 14 How would you like to work/learn in future?

SIT's Punggol campus and Jurong Lake District are changing the way we work and learn

### INSIGHT

#### 22 City essentials

Gearing up our infrastructures and systems for greater resilience

#### 27 Data and planning

URA's data scientist Dr. Alvin Chua on how data science can improve our urban landscape and lives

#### 32 From disrupted to disruptor

4 disruptors are defying space constraints

#### 38 Urban activism is on the rise

5 activists share their passion for making our city better

### IN PICTURES

#### 42 #SINfromabove

Photographer Yeo Kai Wen unveil instagram-worthy drone shots

#### 46 At a glance

6 things to check out this weekend



Cover | The rapidly changing economy is creating the need for the work environment and the worker to adapt and evolve. This illustration by Jeanette Yap imagines possible work environments in future, open the cover to see the full illustration.

### Editorial team

Serene Tng

[serene\\_tng@ura.gov.sg](mailto:serene_tng@ura.gov.sg)

Michelle Lee

[michelle\\_lee@ura.gov.sg](mailto:michelle_lee@ura.gov.sg)

### Contributing writers

Jennifer Eveland

Justin Zhuang

Lee Wai Kin

Michelle Ng

Nicole Mah

Sofiana Ramli

### Photographers/Illustrators

Donn Tan

Jeanette Yap

Robin Thang

Wilson Pang

Yeo Kai Wen

### Illustrations

Green House Design + Communications

### Design

Silicon+

### Published by



45 Maxwell Road

The URA Centre

Singapore 069118

Connect with us

[URA.sg/skyline](http://URA.sg/skyline)



URASingapore



@URAsg

Skyline is published 3 times a year. No part of this publication may be reproduced in whole or part without the prior consent of URA. All information is accurate at the point of printing. All rights reserved.

ISSN 24249971



# Ideas and imagination

The world around us is changing rapidly as we grapple with uncertainties with an eye on the future. Against the backdrop of the Committee on the Future Economy's strategies charting Singapore's future economy released in February 2017, we put together this issue on a quest to understand how we can better prepare for the future and what do we need to do to make our journey more purposeful.

URA's Chairman Peter Ho suggests that we should embrace imagination and partnerships as key to charting our future cityscape. Instead of reducing complexities of the world around us, we should seek to understand and leverage on these to chart our paths. And because our current achievements do not guarantee future success, disruptive innovation expert Professor Luke Williams wants us to look beyond obvious problems to unbroken ones as the richest areas for disruptive innovation.

Gearing up our environments and infrastructures for the future, planners and

all key players shaping these remind us that fundamentally, our physical spaces and systems are intertwined with our own mind sets and lifestyles. It is not about grand designs or mammoth structures, it is about first asking ourselves – how do we want to live our lives in future? How do we want to learn? What kind of working environments will give us greater purpose and meaning? How do we want to move our goods around the city or handle our waste? It is from this basis that exciting new work/learn/play spaces are envisioned in Punggol Digital District and Jurong Lake District. And inventive ways are dreamt up to design even more resilient and robust systems that will enrich our lives.

In our quest for a greater future, every individual will matter even more. Because our success depends on the sum of thousands of city hacks, innovations and ground-up initiatives led by passionate citizens. From industry disruptors to business leaders and students – we find stories of how each are redefining and shaping our worlds.



5 million

The number of data transactions generated and analysed in real time in JTC's integrated smart estate and building operations system known as J-Ops – a more proactive approach to managing energy consumption.

“It takes a lot of hard work so stay curious. Try not to get distracted, always focus on the problem and look at it from different angles.”

Alvin Chua's advice to aspiring data scientists, he is part of URA's 15-man team in the digital planning lab set up in 2013 to exploit advanced digital planning tools and emerging technologies to transform the way planners work.

“You spend so much time at work. If you don't enjoy what you do, then you might as well enjoy where you work.”

Ben Gattie, co-founder & ceo of The Working Capitol is leading on co-working spaces, aiming to make the work environment more meaningful for workers.

1,000

The number of students who attended URA's second annual Urban Planning Festival held in March 2017 to educate aspiring planners and architects on the intricacies of urban planning and design.

100,000

The number of new jobs envisioned under the master plan unveiled for Jurong Lake District, Singapore's second CBD.

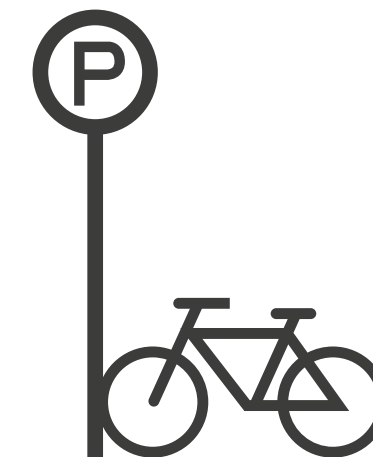
“There is a need for us to equip our young people with deeper skills...and continue to adapt to a changing future.”

Lifelong learning is a key focus for the new SIT campus in Punggol where work/learn spaces are integrated encouraging greater interactions amongst workers, students and the community, shares Professor Tan Thiam Soon, President of Singapore Institute of Technology (SIT).

## More reasons to cycle

Developers are responding to consider needs of pedestrians and cyclists.

Since the introduction of requirements for property developers to take into account the needs of pedestrians and cyclists in their developments by URA and the Land Transport Authority from July 2016, 30 applications have been received so far, with some going the extra mile like Paya Lebar Quarter and Funan Mall. The upcoming Funan Mall will offer a full range of facilities like showers, lockers and bicycle shops. Kevin Siew, Vice President of Retail Development, CapitaLand Mall Asia Limited, shares that Funan Mall will be linked up to the larger cycling and pedestrian network in the area. “We want to make Funan more accessible for all commuters,” he adds.



Scheduled to complete in late 2018, Paya Lebar Quarter will also have a comprehensive end of trip facilities and a walking and cycling path integrated with the wider park connector network. This is “to encourage a wider adoption of personal transportation devices and public transport for a less car-dependent future,” says Richard Paine, Managing Director, Paya Lebar Quarter, Lendlease.

The requirements are part of the continued shift towards a more car-lite city. For developments that have high footfall, like schools, shopping malls, office buildings and business parks, developers are to consider planning for their developments to have direct pedestrian and cyclist access from nearby public transport networks. In addition, there should be sufficient bicycle parking spaces and amenities for cyclists like shower rooms and lockers and designing barrier-free access and routes for use by children, the elderly and disabled.

For more information on the requirements, go to [www.ura.gov.sg/uol/circulars/2016/May/dc16-08](http://www.ura.gov.sg/uol/circulars/2016/May/dc16-08)

### Walking and cycling plan – 4 key components

- 1 A location plan** that outlines the location of amenities, major transportation nodes and routes around the development like bus stops, cycling networks, MRT station, etc.
- 2 A conflict plan** that identifies potential conflict areas between vehicular traffic and pedestrians and cyclists and suggests solutions to minimise conflicts.
- 3 Provision of bike parking lots** that commensurates with the use and size of developments. Design of spaces should consider the accessibility and safety of cyclists in getting to the bike parking lots and facilities.
- 4 Provision of facilities** that serves the convenience of cyclists. There should be sufficient provision of facilities such as showers, toilets and lockers.

# New recipe for the future?

Disruptive innovation expert Professor Luke Williams suggests that charting Singapore's future may involve looking at parts of the city that are working and not obvious.

Writer **Jennifer Eveland**



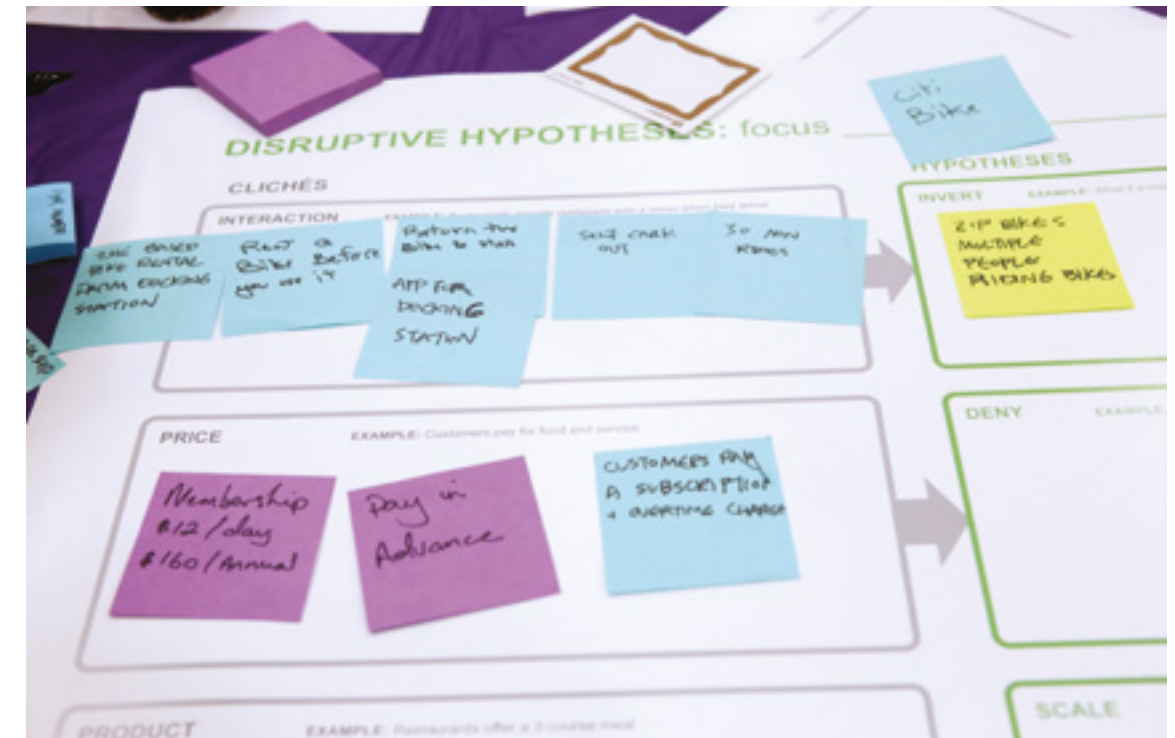
"There is no guarantee that what has been done to become successful up to this point is going to ensure success in the future," says Professor Luke Williams, a leading consultant, educator and speaker specialising in disruptive innovation.

The author of *Disrupt: Think the Unthinkable to Spark Transformation in Your Business*, Luke serves as executive director of the W.R. Berkley Innovation Lab and clinical associate professor of Marketing and Entrepreneurship at New York University Stern School of Business.

## Why we are stuck

He says that while most people are familiar with ideas of disruptive innovation and disruptive technology, he is interested in disruptive thinking, which he describes as the exploration of provocative ideas that may be inconsistent or even in conflict with an organisation's current trajectory.

Once an organisation has found a formula for success, Luke explains, the tendency is for it to continue doing what works. However, he says, if the organisation is only focused on keeping its



existing engine going, it will eventually run into trouble. Because people tend to get comfortable with what's familiar, they become trapped by ingrained perceptions and are unable to recognise new and novel ideas they have never encountered before.

As a result, he says, most of the Fortune 100 companies he works with make the mistake of spending huge amounts of money and resources making incremental changes to their existing products, services and models. Eventually, some of these companies find themselves on a path that gets narrower and narrower, to the point at which their customers have forsaken them for a newer offering that nobody saw coming. And in cases where companies do take disruptive risks, Luke says it's typically because they are backed into a corner and have no other choice.

## Breaking out

"We just love management by crisis," he says. "Crisis situations unlock a ton of energy in an organisational structure. Suddenly budgets open up and money seems to fall from the sky. People that were too focused on their core business are available to work in response to the competitive threat."

"The whole point of disruptive innovation is about doing the work of crisis without the crisis.

It's about making bold moves even when you're at the peak of your success," says Luke.

"It's not about reinforcing continuity, but evaluating a steady stream of unconventional strategy options – strategy options that have nothing to do with your existing business or trajectory," he says. "The idea is not necessary to change the way you're operating, but to change the way you're thinking, which is actually a stabilising mechanism because it means you're building options for the future."

He suspects, however, that people are suffering from innovation fatigue, worn out by endless talk that they need to constantly change and admits that few people are motivated to disrupt. But most people and organisations are motivated to grow, he says, and innovation and growth are connected.

## Rethinking the city

In Singapore, concepts of disruptive technology and disruptive businesses were interwoven into the February 2017 report by the Committee on the Future Economy, where they were presented as strategies to help clinch Singapore's competitive edge in a fast-changing world. Given an uncertain economic future shaped by sluggish global growth and productivity, ageing populations, shifting global value chains and rapid



technological change, could it be that radical, or disruptive thinking offers a way forward?

In considering Singapore, Luke believes that it is precisely because of Singapore's successful track record that the city-state stands to benefit the most from disruptive thinking, which he describes as the exploration of provocative ideas that may be inconsistent or even in conflict with an organisation's current trajectory.

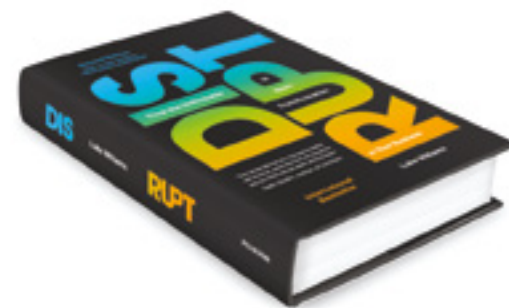
He believes a process of disruptive thinking can be adopted with the spirit of creating a new recipe for the nation.

"Pay attention to ingredients that have been ignored and ingredients that are not obvious," he says. "Look at the ingredients that are on your table right now, ingredients that weren't there when the city was first planned decades ago. That process will force everyone to confront the

decisions that are influencing the way they think about Singapore as it is right now. How many of those decisions were made in a different age or in a different context?"

He adds, "If you ask people, where do we start thinking about the future of Singapore, most people's attention will focus on the problems. What are the problems at the moment? What are the things that need to be fixed? The problem with problems is they're seductively clear, meaning they're screaming for attention, which typically means that in an organisation, or in a city, they're the only things getting any thinking attention."

This, he says is the richest areas for disruptive innovation: "the seemingly unbroken aspects of the city, of the environment, the areas where absolutely nothing appears to be wrong."



*Luke Williams is one of the world's leading business thinkers on innovation strategy. He is a Professor of Marketing at the NYU Stern School of Business and Founder and Executive Director of the W.R. Berkley Innovation Labs. He has designed more than 100 products in a range of industries and have delivered management talks in many countries around the world. He is also the author of the book, Disrupt: Think the Unthinkable to Spark Transformation in Your Business.*

# Planning for uncertainty

URA Chairman Peter Ho talks about why imagination and partnerships are key for our future.

Writer **Serene Tng**

With the release of the Committee on the Future Economy (CFE)'s strategies charting Singapore's economy earlier in 2017, we catch up with URA's Chairman Peter Ho on how planners are gearing up the city for the future.

**1. From sluggish global growth to protectionist economic agendas, the effects of climate change, and of course the rapid pace of technology – the future economy of Singapore has never been so uncertain. How does a city prepare for such uncertainty in its environment and design?**

Cities, like any human systems, are inherently complex. Connections and interactions among agents in a complex system lead to outcomes that are unpredictable. But just because we cannot predict the future does not mean that we can ignore the complexities of the world.

What cities can do in the face of uncertainty is to continuously evaluate the evolving context, and put in place policy options and plans to deal with changes that we can anticipate. In Singapore, we do this through our Master Plan

and Concept Plan process. While these are mid to long range plans that attempt to look many years into the future, we review these plans regularly to ensure their relevance to the changing external environment. This fosters a habit of thinking about our future while balancing short term needs.

Even while we look ahead, the policies and plans that cities formulate should build in sufficient flexibility to allow the city to remain nimble and adapt to different scenarios, possibilities and outcomes quickly. In Singapore, recent pilots with more flexible land use approaches in Woodlands and Punggol are examples of how planners are introducing greater flexibilities in the way we design our environments that can foster deeper synergies and richer ecosystems.

Because there are no perfect answers, a useful way to prepare for an uncertain future is to constantly experiment and accept failures as part of the journey. The ongoing trial of driverless cars on our roads and Car-Free Sunday SG are good examples of beta-testing the desired future and reflect a more inclusive process in designing our future environments together.





**2. The CFE advocates for businesses and citizens to play bigger roles in building our future city, suggesting for private firms to be given more master developer opportunities to develop and place-make key precincts. Plans are underway to support greater empowerment with the pilot enterprise district in Punggol and exploration of the Business Improvement District, a more formal place management framework. Why are such public-private partnerships important for dealing with future uncertainties?**

The view that the government knows best is increasingly challenged in today's world where citizens and businesses can easily gain access to much of the information that governments used to monopolise in the past. The deeper partnerships that we are evolving reflect a major shift in the way we govern from the 1990s towards a more networked government, where it is coordinating efforts across groups, harnessing new information technologies and partnering stakeholders to implement urban solutions.

Partnerships will become more fundamental in the way we confront challenges of our time.

Rather than the government having sole monopoly of ideas, the model of governance will be anchored in increased collaborations across public, private and people sectors where more opportunities are created for ground-up initiatives and innovations. If we are able to facilitate more meaningful partnerships, we are also building greater trust, sense of ownership and resilience. Such partnerships open up new possibilities, for example, the master developer approach adopted for Punggol's pilot enterprise district and Kampong Bugis taps on other expert players to master plan entire districts for more dynamic environments in future.

It is heartening to see many other good examples of partnerships flourishing. Citizens are organising their own street closures under URA's Streets for People Programme and champions are carrying out place management efforts. We are seeing more empowered citizens with the ability to lead and effect change. In supporting this, we need to find the best models that are most impactful, for example, planners are exploring the business improvement district approach to support more sustainable place management efforts.



Above | Debra Lam and Ryan Ng at Peng Nguan street's closure under URA's Streets for People programme in collaboration with Society for the Physically Disabled. They founded Society Staples, a social enterprise which aims to raise awareness for persons with disabilities.



**3. One key driver of change in our current time is the rapid acceleration of technology and innovation. Things that used to be science fiction are now becoming facts of science, and soon features in our daily lives. Self-driving cars and automated drones are two good examples. How profoundly do you think such innovations will impact the way we design and develop our urban environment? What should we do to be leaders in such innovations? What are the pitfalls we should avoid?**

Such innovations can have a profound impact on our environments if they have widespread application and a positive impact on the way we manage the city and on people's lives. The government has a key role to play in understanding how technology develops and impacts us, in connecting such innovations to the larger societal environments and in testing these in real environments. An example is in the one-north precinct, a cluster hosting research facilities. The area is used as a major pilot for the use of autonomous vehicles, testing not just the technologies for cars but also for the road furniture.

Leaders who are driving change and innovations must be able to persuade people on the need for change, instilling confidence and empowering the right people. They must allow for expressions of opinions and create the capacity for risk taking and failures.

With the acceleration of technologies in the context of a Smart Nation, one major misconception is that with a 24/7 online world constantly surrounded by innumerable sensors and smart objects, all connected to the Internet – the Internet of Things – absolute privacy and absolute security can be achieved. To overcome these misconceptions, a mature discussion is needed where leaders have the responsibility to explain how benefits far outweigh the risks of exploiting technologies and how risks can be managed. We also need to be careful not to adopt technology for the sake of it. It should be used as a tool to help meet the needs of people and to deliver better services to citizens. A Smart Nation should ultimately be driven by smart policies that improve citizens' lives and develop a society of empowered individuals.

**4. As we embark on developing Singapore to be a smart nation, we are also mindful that a city is not solely about technology and innovation, although these are important. We would still need to balance it with other aspects to make our city delightful to the human spirit – heritage, vibrant streets and biodiversity, etc. What makes a city charming and delightful to you?**

People love a city not because it is great. A city is great because people love it. What makes people love a city? Well, a charming and delightful



city is one where it is constantly surprising and engaging whether in lively public spaces, in well-designed buildings or in well-connected and integrated districts. There is life and soul in places as destinations where people and strangers feel

connected to. There is diversity in experiences in being able to savour quiet moments sitting at a park bench or embracing vibrancy in a busy street. There is an ease and comfort in moving between spaces that feel both familiar and



Above (top and bottom) | Whether it is benches crafted from historic seating planks of the former National Stadium or the restoration of Kranji Marshes, there is a diversity of delightful places for all to enjoy.

It is the ability to steer, to connect the dots not just locally but globally that will help us manage accelerated changes that are exponential and non-linear.

yet different, that grows and adapts with our identities and communities. And there is a harmony and blend with our natural surroundings, with nature, and waterways. And one that connects us to the past yet gives us a glimpse of the future. Ultimately, it is one where we feel included and a sense of belonging. Beyond these softer aspects, we cannot enjoy the city without its efficient functioning that makes our lives easier and more comfortable. The quality of our lives is intertwined with how effective and robust our infrastructures and systems are. And hence we need to continue to invest in and enhance our systems and pursue innovations in this area to ensure that we are not only strengthening our resilience but continue to keep our city lovable.

**5. Planners today have to manage far greater complexities where there are no straightforward or obvious solutions. How has the role of planning evolved and what critical values and skills should planners have to embrace in shaping our future?**

Certain fundamentals remain when it comes to urban planning – a uniquely complex problem for Singapore. Planners need to continue to take into account the challenge of packing in housing, green spaces, industrial land, land for transportation, military training areas and many other uses all within the confines of 719 square kilometres with Singapore as a city-state. Our priorities also remain the same – catering for economic growth, maintaining a clean and green environment, making best use of our resources and providing a good quality of living and sense of well-being. In achieving our objectives, what has constantly guided us well will continue to anchor our planning approach focused on being far-sighted, holistic and comprehensive. This allows us to prepare for the future yet be grounded in responding to surprises and adapting to changes along the way. What has evolved is the role of a more networked government that will see a greater emphasis in facilitating and fostering

partnerships and providing platforms and environments for ideas and innovations to flourish. It is the ability to steer, to connect the dots not just locally but globally that will help us manage accelerated changes that are exponential and non-linear. In embracing the future, we need to constantly develop new skill sets in futures thinking and learn to leverage technologies effectively for significant outcomes. Planners are already taking the lead in this space developing many critical tools like the e-planner and other platforms. A one-stop geospatial planning analytics platform with over 100 data sets developed by URA in-house, the e-planner is now used widely by government agencies. It enables planners to visualise and go deeper in understanding city dynamics to make more evidence based decisions. Ultimately, we need the courage to re-write stories we tell about ourselves, the imagination to reinvent our identities where needed and the humility to change decisions when we go off course. In charting our future, planners need to tap on this courage and confidence in embracing changes and opportunities grounded in our shared values and destinies.

*Peter Ho is the Senior Advisor to the Centre for Strategic Futures, a Senior Fellow in the Civil Service College, a visiting Fellow at the Lee Kuan Yew School of Public Policy, and the current S R Nathan Fellow for the Study of Singapore at the Institute of Policy Studies. When he retired from the Singapore Administrative Service in 2010 after a career in the Public Service stretching more than 34 years, he was Head, Civil Service, concurrent with his other appointments of Permanent Secretary (Foreign Affairs), Permanent Secretary (National Security & Intelligence Coordination), and Permanent Secretary (Special Duties) in the Prime Minister's Office. In addition to being URA's Chairman, he is also Chairman of various other organisations like the Social Science Research Council, Singapore Centre on Environmental Life Science Research Council and many others.*



# How would you like to work/learn in future?

Lively, engaging and open with free flow of ideas – we look at how SIT's Punggol campus and Jurong Lake District's master plan are changing the way we work and learn for tomorrow.

Writer Jennifer Eveland







“Twenty years ago if you can drive, you can be a taxi driver, you can be a bus driver, you can be a truck driver. It’s enough for you to have a roof over your head, put food on the table and raise a family. You can live a life. Today, that same skill is not going to be relevant and there are many other jobs that you can count that will go down the same road. So there is a need for us to equip our young people to have deeper skills, understand what the industry needs and be able to continue to adapt to a changing future,” says the Singapore Institute of Technology (SIT) president Professor Tan Thiam Soon.

#### Lifelong learning is a must

Lifelong education is now a must have and not good to have, Thiam Soon adds in explaining the premise of the new SIT campus in Punggol. “Now we have the opportunity to redefine what lifelong education really means, getting the community to understand. When SIT moves to Punggol, the whole concept is to integrate with JTC’s business park as well as the community so that SIT can help to lead that change for people to embrace education in the community. It is not just the worker or student, it includes even students who are not in SIT but are still growing up in school. How can young people come to SIT and see the bustle of activity and say wow, not only is

there an exciting future, I’d like to be a part of that future. Then the question is how do I get to that future? And we want to be that space that inspires them for that future.”

The new SIT campus in Punggol will be located in the Punggol Digital District, a growth area in the northeast, focused on digital and cybersecurity industries and is a key area to drive the government’s smart nation initiatives. A unique part of the campus will be the open and porous space integration between the university and JTC’s business park located just next to the campus. A first of its kind, this allows for students and workers to interact freely, cross-sharing resources and ideas, creating a whole new ecosystem.

#### More flexible land use

To support the planning and design of this open environment and the evolving economic and manufacturing landscape, URA planners have worked closely with key agencies and stakeholders to allow for more flexible land use, piloting the area as an Enterprise District as announced in March 2017. JTC, the lead agency for industrial development, has been appointed its master developer. This means instead of having land use controls imposed on individual land parcels, the controls are applied over the entire

district where JTC is empowered to plan and develop the district in a holistic manner. JTC will be able to better optimise land use across the whole district by finding new ways to integrate the needs of different users. The flexibility to seamlessly change use of space and respond to demand will keep the area attractive and competitive.

For example, with SIT’s campus and JTC’s business parks located side by side, there can be closer integration of facilities. SIT’s research labs and learning facilities can be located within JTC’s business park buildings and shared with the industry. At the same time, SIT can also host industry research and development facilities and start-up spaces within their campus, allowing a greater intermingling of students, researchers and industrialists for a dynamic business environment.

#### Next generation work spaces

David Tan, JTC’s assistant chief executive officer sees a greater integration of live, work, play and learn spaces in the next generation of industrial estates and business parks. “It is about making work environments more enjoyable for the industry, where they are highly liveable, sustainable and connected in order to continue to attract the best talent,” he adds. It is in more open, collaborative environments that ideas can grow where start-ups can mix freely with larger firms to leverage each other. Such integration can also reduce business costs where they can benefit from shared services and district-wide systems that can be applied like district cooling systems, he adds.

It is also about creating a sense of community and meaning that allow workers to feel more fulfilled at work. JTC has already taken steps in this direction for some of its current industrial estates and business parks like Seletar Aerospace Park and one-north. At one-north, workers hang around after hours and on weekends, mingling at movie nights and tech-centred races and competitions, some of which are also open to the public.

“In some sense we are acting as a place-maker,” says David, referring to the process of planning spaces with a sense of identity inspired by the cultural and community assets of a place. It is part of a greater effort to build industrial facilities that will meet the needs of businesses and workers as they evolve.

## Woodlands pilot for more flexible industrial space use

In further supporting the changing business landscape, URA and JTC are piloting new land use guidelines at a multi-tenanted building to be developed by JTC and located within Woodlands North Coast on a site zoned Business 1-White. The pilot development will support co-location of service-driven activities like research and development and after-sales support alongside manufacturing operations. A wider range of uses will also be allowed including industrial related activities that provide critical support for the industrial sector.

Given land constraints, land is safeguarded for industrial activities through land use zoning. Over the years, URA has progressively updated and revised its industrial policies and the pilot is part of the effort to be responsive to changing industry needs. The Woodlands North Coast is part of the broader Woodlands Regional Centre, a significant employment cluster for the north region. The building is expected to be completed by 2019.

#### Bringing people together

In bringing workers and students together, Thiam Soon envisions maker spaces and tinkering spaces that are visible, not hidden in labs where real life prototypes are developed. The design of porous spaces between the campus and business park is key and also connecting with the community at large. “We will still have certain secure areas where our students and staff can work in peace but a large part of the campus, especially at the functional, common levels, will be totally open,” explains Thiam Soon.

Right in the centre of SIT where most universities have their quadrangle will be a public park, a park that doesn’t belong to SIT but is a park for everyone. This porosity reflects Thiam Soon’s emphasis on lifelong learning: “The whole challenge of the future economy and the whole challenge of lifelong education, is this mindset about breaking down. It is not about just completing each stage of life from secondary school to university or even landing that first job. What you want to stretch is that now, it is going to be a continuum.”



This porosity and bringing people together is something that many places try, but not that many have got the magic right. We want to get that magic to be correct at Punggol, shares Thiam Soon. “The challenge is in facilitating conducive interactions. The company, SIT professors, students, professionals and the community. Besides the university and industry, the community is actually finally the consumer. So in the prototyping, they come in and see and say that’s not really what I want, it’s what you want. Can we bring them together in this rethinking about how we make the space open and bring different groups of people together?”

How we integrate spaces and people well in future will be a major challenge for such mixed use districts, adds David. Another challenge he sees is the effective leveraging of technology and automation and application of data science to help transform industries to be more productive and valuable.

Whether in space planning or investing in people – Thiam Soon says it is all about being nimble and responsive to a changing future. He envisions that a lot of physical spaces are going to be less compartmentalised with more open ones that can be configured much more easily. He adds: “There will also be more crystal ball gazing to ask ourselves what does learning look like in 2030, what does a library look like 2030 and what does a learning space look like in 2030? We are probably going to get quite a number incorrect but we still have to take a step. In instilling in our students a DNA of learning, unlearning and re-learning, where they go to every place or job and constantly ask how I can make it better, we want to put across the message that you don’t need to change the world. You just need to change small things one bit at a time.”

**Singapore’s second CBD**

Jurong Lake District is the largest regional centre planned outside the city centre and serves to offer more jobs closer to home. First identified for development as a regional centre in 1991, the area has since shed its industrial image and is transformed into a vibrant mixed-use business district anchored by the Jurong Gateway commercial node around Jurong East MRT station and Lakeside, focused on leisure and recreational activities.

With the location of the Kuala Lumpur-Singapore high speed rail terminus to be completed by end 2026 and its close proximity to universities, research and high value industries, together with the Tuas port completed by 2021 in



phases, the district is poised to support the future economy with adaptable work environments, a sustainable mobility focus, green and blue spaces, supported by smart and integrated urban systems.

URA unveiled the detailed master plan for the area on 25 August 2017, inviting the public to share their views. A team led by KCAP Architects&Planners (KCAP) was appointed as consultant to develop the detailed master plan for Jurong Lake District in February 2017 following URA's earlier request for proposal in 2016. The team was selected from 35 interested groups and shortlisted from the final five and consists of KCAP, SAA Architects, Arup, S333 and Lekker.

**Kees Christiaanse on Jurong Lake District**

KCAP founder Professor Kees Christiaanse talks about what makes the district different from others, how it will help the future economy and why it is a district for everyone.

**1. What is it about the way Jurong Lake District is planned and designed that makes it stand out?**

The district can potentially become a model for a high-density urban area with high quality public transport nodes, an example of what we call transit-oriented development, which is kind of a new word used to describe such an urban node.

The district is also a transition between international, intercontinental and local connections. There will be two more MRT lines, for instance, and then of course we have the conductivity by the port for the industry which can potentially generate a lot of industry port-related

innovative enterprises in the district.

Public and building interior spaces will be designed to be more adaptive to changing circumstances like economic demands or population diversities. The interesting combination of mixed uses like residential, commercial, education and entertainment will also demand a more far-reaching adaptability and flexibility in the use of its spaces.

**2. How will green spaces feature in the district?**

These will be the anchor for the district. Besides the Jurong Lake Gardens, a new central park will be planned on top of the High Speed Rail tracks and an MRT station that will run east to west through the site. The central park will be linked up to the Jurong Lake Gardens and future Round Island Route. The third park will be along the north-eastern shore between the New Science Centre and the existing Science Centre. The spaces in between these parks will be compact with almost every building enjoying a direct view of a park or waterfront – this creates a very good quality environment.

**3. What are some important concepts pursued for the district?**

The high-density aspect is quite unique and it is exciting to be given the opportunity to create a district that balances such density and yet be an attractive green area for leisure and sustainability. These are not necessarily contradictory as what people assume. With creative typologies as what we are doing for Jurong, we can accommodate a wide range of mixed uses.





The other important strategy pursued for the district is sustainable mobility. We are envisaging a neighbourhood that is primarily walkable and cyclable and in the future, there can be driverless electric public transport within the precinct with optimal connectivity to different MRT and railway stations. We also have streetscapes that can evolve in the future along with innovations in public transport.

#### 4. How do you anticipate public adoption of these approaches?

This depends on two things, cost and comfort. Comfort is about how far I have to walk to get to a quality public transport network. Singapore is like Tokyo or Hong Kong where car use is hopefully a kind of temporary condition which can be reduced by the innovative mobility systems that are coming in the future.

#### 5. What are the strengths and assets of the district?

I see the district as an innovative cluster. There is an enormous amount of knowledge industries around the area. You have the university town, there is Kent Ridge campus, one-north, Nanyang Technological University and the clean tech park, etc. There is a very good clustering of knowledge institutions and industries. At the same time, there is the port where an enormous amount of innovative activities are going on in terms of logistics and automation that is critical to the future growth of the port and supply chain management sectors. There will be a lot of synergies to be leveraged across these clusters, and Jurong Lake District, with its open environment and strategic location, can be the meeting place for these sectors to flourish.

#### 6. How can Jurong Lake District contribute to Singapore's future economy?

If you look at many high density urban areas, a lot of innovation and growth happen in such places. The district is the base from which a kind of cocktail of innovative people can come together within very attractive environments with a lot of flexibility. And this will have far reaching effects on knowledge development and economic growth.

## Key highlights of the Jurong Lake District master plan

### Greater Jurong Lake District



like public transport, autonomous vehicles on demand, car-sharing and personal mobility devices will take centrestage. Dedicated transit corridors are planned for residents, workers and visitors to move around easily and to MRT stations. It is envisioned that the target mode share of more than 80 per cent of all trips will be made via public transport, higher than the current 66 per cent islandwide.

#### Green, blue spaces for everyone

Capitalising on the lake and national gardens at the district, unique green and blue assets will be enhanced further with a recreational belt created within the mixed-use business district and the future high speed rail terminus. 100 hectares of park and open spaces will be added. All new developments will feature skyrise greenery, forming a 'green carpet' in the sky. A new water channel is also planned for Jurong Lake, creating an extensive waterfront space for all to enjoy.

#### Smart, sustainable district

The district is envisioned to be one of the most sustainable district in Singapore with targets set, for example, all new buildings will be required to achieve a Green Mark rating to reduce energy consumption by up to 30 per cent. Smarter and more integrated urban systems will be explored like the district cooling system, common services tunnel and the pneumatic waste conveyance, and these will be located underground to free up land for housing, greenery and other uses. In addition, the district can potentially further leverage on infrastructure design, technology and data to optimise and influence lifestyle choices and resource consumption.

*The detailed master plan for Jurong Lake District is now on display at The URA Centre from 25 to 31 August 2017 and at Westgate from 8 to 17 September 2017. For more information and to give your feedback, go to [www.jld.sg](http://www.jld.sg)*

#### Vibrant CBD with adaptable spaces

As Singapore's second central business district (CBD), Jurong Lake District is envisioned as a lively, vibrant mixed-use business district with a live-in population and an attractive street life.

With business needs evolving in the knowledge economy, more flexibility and adaptability is addressed at the design stage within proposed structures to cater for changes and evolution in future. A regular grid system for land parcels in the district offers flexibility in providing larger or smaller land parcels to meet different needs while a 'white' zoning for most sites in the mixed-used business area enables landlords and tenants to mix various uses like schools, community facilities, attractions and event spaces within a building, adapting spaces for future needs. Ground floors of developments will also have generous public spaces and through-block links for greater interactions and networking, creating a lively streetscape.

#### Shift towards sustainable mobility

The district offers a shift in paradigm to more sustainable mobility where green mobility options



# City essentials

Gearing up our infrastructures and systems for tomorrow.

Writers **Jennifer Eveland** and **Serene Tng**  
Illustrator **Jeanette Yap**

For those of us living in urban areas today, which is over half of the world's population<sup>1</sup>, these are a few typical activities we might do each day:

showering in the morning with clean water  
throwing out the trash from last night  
taking the train, car, bike or scooter to work  
making a quick purchase from Amazon  
daydreaming about our next vacation abroad

Behind almost every simple task, there is an invisible world of systems and structures around us that are intricately intertwined with our lives, sustaining our everyday activities. We may only pay attention when the train breaks down, the rubbish chute smells or our parcel doesn't reach us on time. Then again, we might just shrug these off as inconveniences and accept our mammoth infrastructures and systems as they are.

American urban designer and planner Ryan Gravel thinks otherwise. In his latest book, *Where We Want to Live*, Ryan highlights how city infrastructure is directly linked to how we live, and how our dreams to lead better lives can inspire us to design infrastructures and systems that support those aspirations. The challenge is in creating systems and ecosystems that are adaptable to future needs and able to manage huge volumes quickly and efficiently, leveraging synergistic domains yet capable of supporting individual lifestyles and needs at a micro level.

We take a look at upgrades and innovations around Singapore that impact the quality of our lives and help us stay resilient.

## Resilient energy management



J-Ops, JTC's integrated smart estate and building operations system, promises to change the way buildings and facilities are managed, in a preemptive way, by tapping in on big data. The system is linked to 19,000 data points from 21 mechanical and electrical systems, where five million data transactions generated round-the-clock are analysed in real time to identify faults and sub-optimal configurations. By tapping big data, sensors and analytics, J-Ops can potentially help to reduce energy consumption and improve productivity in the facilities management industry.

## New kind of waste management



Our waste is ever-growing and in enhancing our waste management capabilities further, the National Environment Agency is building a first-of-its-kind

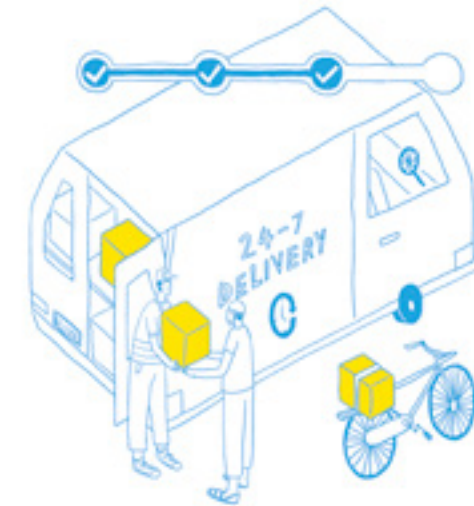
## More pleasant waste collection

Gone in 60 seconds – that is how fast rubbish at Yuhua neighbourhood will reach a centralised bin centre, sucked through underground pipes at speeds of 50 to 80 kmh. This pneumatic waste conveyance system, installed by the Housing & Development Board (HDB) for 38 blocks in Yuhua, is the first and largest of its kind in Singapore. Piloted in 2015 under HDB's Greenprint plan to guide the development of greener public housing estates, the system changes the way waste is collected, doing away with waste collectors having to go block to block, and reducing the risks of pests and unpleasant odours. This cleaner and labour efficient system will be installed in new HDB housing projects in areas such as Tampines North, Punggol Northshore, Bidadari and Sengkang.



integrated waste management facility in Tuas View Basin. The facility can process multiple waste streams – up to 5,800 tonnes of incinerable waste, 250 tonnes of household recyclables and 800 tonnes of food waste daily. At a mere 68 hectares, the compact design offers a new model of sustainability and resilience, while its location, beside the Tuas water reclamation plant, will leverage synergies between the two plants, including the supply of power to the water plant. The electricity generated by the facility will be able to power up more than 400,000 four-room HDB households. The first phase is expected to be completed by 2024, with flexible features designed to adapt to future needs.

## More seamless goods delivery



Online shopping is incredibly convenient, until your package is delayed or lost in transit. With the rise of e-commerce, more frequent and customised deliveries are expected, right down to smaller packages. Both public and private sectors are actively addressing the challenge of urban logistics. Robert Yap, executive chairman of YCH Group sees it as optimising trips and fleet movements for parcels and goods to reach people efficiently while minimising traffic on the roads. As Singapore's largest homegrown urban logistics player, YCH Group headquarters is located within Supply Chain City in the Jurong Innovation District. This state-of-the-art facility houses SCTower™, which tracks the company's logistical operations world-wide with real-time data visualisation and YCH Group's patented Fusionaris®, an integrated automated storage and retrieval system (ASRS) and ramp-up facility with cutting-edge robotics technologies such as autonomous guided vehicles and drones.



Cooling on a grander scale

Deep below the iconic Marina Bay lies the world's largest district cooling system (DCS) that runs 24/7, keeping the precinct cool in our tropical climate. Five storeys tall and 25m deep, this underground facility is a significant piece of infrastructure that planners envisioned in the 1990s and catered for in their systematic mapping of underground space in Marina Bay. A first in South East Asia, the tunnel demonstrates how locating suitable uses underground can improve operating and environmental efficiency and free up land for a more vibrant environment above ground. A recent innovation is an outdoor hybrid cooling system introduced to cool public spaces like the floating platform where National Day celebrations have been held. On the use of our underground space, a global benchmarking study by URA and Arup offers valuable insights. A highlight is to develop a 3D underground master plan to safeguard underground space upfront.



Mobility for everyone

With 12 per cent of our total land area lost to roads, which is close to 14 per cent taken up by housing, there have been significant shifts in the way we move around our city with an emphasis on lesser use of cars. From building up public transport networks and services to creating more cycling and walking towns, leveraging technology and data analytics to make travel more seamless and experimenting with driverless cars, the key to making the final mile leap is in creating a more inclusive, and sharing mentality for every path, rail and road user. It will continue to be an ongoing process to ensure harmony amongst all stakeholders, says Denis Koh, chairman of Big Wheel Scooters, an online community for e-scooters.



Shaping the future of air travel



The future of travel will be about how to further humanise our travel experience while increasing capacity to handle increasing demands. Changi Airport's Terminals 4 and 5 when opened later in 2017 and late 2020s respectively, will allow Changi Airport to handle a total of up to 135 million travelers every year. Both will leverage technology and big data to ensure greater operational efficiencies, enhanced passenger experience and allow for adaptable physical spaces to meet future demands. Planners are also looking into further improving air connectivity with the region by intensifying links to major international hubs from Singapore while creating synergistic ecosystems around the airport to serve visitors, industries and businesses.

New port at Tuas

We can thank our maritime port for most of our imported goods, but it also provides more than 170,000 jobs and contributes some seven percent to the nation's Gross Domestic Product (GDP).<sup>2</sup> The new Tuas port, to be opened in phases from 2021, is expected to handle more than double the volume of Singapore's current ports in 2016. Tuas will likely employ smart and green technologies including the use of drones for ship-to-shore delivery, automated and electric cranes and vehicles, digital tracking of arriving vessels, and a just-in-time arrival system that will reduce delays. Upon completion in 2040, the port will be twice the size of Ang Mo Kio town and replace Pasir Panjang, Tanjong Pagar, Keppel and Brani ports. Planners are also studying ways to optimise above and underground spaces for a variety of port-related activities.



Future of sea, air hubs

What will the future of our port and airport look like and how are we gearing up? We catch up with Tan Chong Meng, group chief executive officer of PSA International and Phua Chai Teck, director (airport development and planning) of the Civil Aviation Authority of Singapore who discuss the future plans for air and sea connectivity.

How do you think maritime and aviation will contribute to Singapore's future economy?

**Chong Meng:** PSA's primary purpose is to be competitive and relevant to global industry and global markets, because transshipment is 85% of our business. Around 50 years ago, Singapore created a vibrant and relevant port to serve the region first and then the world. As a result, the port punched above its weight. Tanjong Pagar, Keppel, Brani and now Pasir Panjang have continued to put Singapore on the international maritime map. In future, Tuas must continue to be that shining harbour, and to do that we must be technologically resilient and innovative, and our operations must be at the top percentile of global competitive ports.

Because of PSA's size and the international volume that we serve, local manufacturers will continue enjoy the benefit of scale. As we move forward, Tuas can be a strong contributor to Singapore's manufacturing competitiveness. We must plan Tuas to interact with manufacturing and supply chain, more than we do today. Manufacturing is getting smarter and technology is getting more efficient, so the supply chain is also changing and evolving. Previously, across the supply chain, people tended to operate within their respective segments, so flow has not been optimised. There is an opportunity for the players across segments to redesign a more efficient supply chain.

**Chai Teck:** The core of our overall vision for Changi Airport is for it to remain one of the world's top international air hubs, supporting Singapore as a global hub for business, trade and tourism. Terminals 4, 5 and Jewel are all meant to provide Changi with the capacity to grow further, capture market and mind share, and enhance our connectivity to other cities. These exciting new projects will in turn enable our economy to tap opportunities and have increased access to markets worldwide.

Less tangible, but just as important, we are also quite conscious of the pride that Singaporeans have in Changi Airport, both as a symbolic icon of Singapore, as well as our airport's place in Singaporeans' social memory. We thus want to ensure that the airport continues to hold that special place in Singaporeans' hearts.

<sup>2</sup> Singapore's 2016 Maritime Performance, Maritime and Port Authority of Singapore, news release 11 Jan 2017, <http://www.mpa.gov.sg/web/portal/home/media-centre/news-releases/detail/05460688-fe49-42e7-9740-4ce88b157b46>



## How will the future port and airport be able to accommodate changes and uncertainties in the future?

**Chong Meng:** When we talk about Tuas, we're talking about a mega port that will mature over the next 20 or 30 years. The first terminal will be open in early 2020s, and all four terminals will open progressively, until 2040. Within that time, cargo movement, logistics and the supply chain will change. So it is very important for Tuas to continue to be a test bed. We won't simply implement the best technology available now and consider it done. Tuas must be something that can be morphed or built with plug and play elements that can provide for changes as we go forward.

The problem with a port is that the investment involved is in billions of dollars. We want to build high density, underground and above ground, with heavy columns and structures, which is quite substantial, but if you want to change something, your degrees of freedom may be limited. So I think we have to balance between building for the best intensification and multi-use possibilities, and at the same time preserve flexibility to respond to diverse future scenarios.



**Chai Teck:** Given that Terminal 5 is intended to accommodate growth for the next few decades, we are working with stakeholders to ensure that its design will be adaptable to accommodate changes in air traffic growth, aircraft technology, airline operations, passenger preferences, operating/ security environments, new technologies, etc.

As a single mega terminal that is expandable through the building of satellite terminals, it will

be designed with a flexible configuration and includes provisions to support future innovations. For example, even as it is designed to accommodate larger future aircraft types, a flexible stand layout will also allow it to accommodate variations in airlines' fleet mix.

In addition, to ensure that Terminal 5 will have convenient links to the rest of Singapore and encourage greater use of public transport, it will be integrated with a ground transport centre that will act as an efficient hub for all the airport's rail, bus and road transport links.

## What might the future of ports look like?

**Chong Meng:** One future scenario might be to look at trends related to advanced manufacturing, smart engineering, renewable engineering and additive manufacturing. Will manufacturing serve local or regional markets? Can the logistical system enable Singapore to become a production centre to serve Asean? Will the goods be fast moving? I think the time will come that with more information on goods and consumer demand, it will be possible to respond to those demands with more bespoke planning. Because of planning capability today, with more clarity from manufacturing sectors and shippers as to what they need and how much they are willing to pay, I think it's possible for a smart port and a supply chain enhanced industrial park to respond to that. Tuas port can collaborate with Tuas industrial park to create a new competitive advantage. For instance, wouldn't it be nice to zone certain parts of an industrial park such that the port can send an automated guided vehicle directly to it?

## What are the main differences between Tuas and the port at Pasir Panjang?

**Chong Meng:** Pasir Panjang has got another 23 years, and its port function is similar to that of Tuas. However, Tuas will have at the back of it a Tuas industrial park, which Pasir Panjang doesn't have. So while functionality is similar, Tuas has an added opportunity to be a real conveyance centre, an optimisation centre of goods production and distribution in a single platform or hub to serve Asean.

# Data and planning

URA's data scientist Dr. Alvin Chua talks about how data science can potentially improve our urban landscape and quality of our lives.

Writer **Serene Tng**



## What do you do as a data scientist?

I try to make sense of large voluminous datasets, to identify useful and relevant patterns about our city dynamics and peoples' lifestyles that can help planners make more evidence-based decisions.

## Why is the collection and analysis of data important for urban planning?

With increasing populations in cities and more complex urban challenges that we face, data and the right kind of information can unlock real insight into travel patterns, demographics, day-to-day behaviour of communities and almost the pulse of the city from moment to moment. This has huge potential to understand what is really going on and to enable us to better manage, plan and design our urban environments and systems now and in future.

## How did you end up being a data scientist working on urban issues?

I have always been interested in architecture and building forms so urban issues come naturally to me. My fascination began as a student in LASALLE when I saw architects create amazing building designs with very sophisticated computing techniques. What they did, drove my fascination in math, and eventually led me to engineering where I spent most of my research developing data visualisation algorithms for the urban planning industry.

## What is it about the craft that fascinates you?

I enjoy experimenting with math and algorithms in general, but my interest continues to change overtime. There was a large emphasis on data visualisation a decade ago and I had a lot fun engineering interactive data visualisation tools. That line of work leaned heavily on (3D) graphics programming and phrases like "dimension reduction" and "manifold unwrapping" were order of





the day. Unfortunately, the bar to entry was high and data scientists spent a lot of time refining tools rather than analytics. A lot has changed. Today, machine learning algorithms allow data scientists to spend more time searching for insights rather than engineering software. This puts data scientists at the foreground, allowing us to make more meaningful contributions. There are many algorithms to experiment with and that number continues to grow as data becomes even more voluminous and complex. There's a lot to learn and I find this really exciting.

**What drew you further into applying data science to the urban agenda?**  
It is a collaborative study with policy makers that I worked on in 2015 as part of my doctoral research that revealed how data driven, evidence based insights can influence the urban agenda and contribute to problem solving. The study focused on tourists' flows in Cilento, a region in southern Italy. Using geotagged data from social media platforms like Twitter, I generated maps of tourist movements that provided insights into how tourism can be tapped to address local economic challenges. While it was challenging

to familiarise with the context and challenges of tourism in a country that I was not familiar with, it was rewarding to see that the study in some ways led to improvements in supporting the local economy, including the ideation of a local "uber-like" system that tourists could use to schedule rides with locals for visits to low accessibility attractions.

**Before we even begin to even use data, what should we bear in mind?**  
Data analysis is as much an art as it is a science. Much of the work involved go beyond math and algorithms. Evaluations are opportunistic and require some rationalisation and critical thinking to realise. Some key questions to ask are:  
"Is there data?"  
"If there is no data, who do we need to convince to get the data?"  
"Is the data collected at the right granularity?"  
"Is the data measuring the phenomenon we want to study or simply a proxy?"  
"How do we account for errors in the data that was not collected by us?"  
"How do we know if the analysis is not biased by the techniques applied?"

**When handling data, what are the limitations to be aware of?**  
Data are numbers, and what matters the most is the interpretation we make. This is why domain knowledge remains important. Another danger is seeing data as a neutral measure just because it comes in the form of measurements. Data isn't perfect since it's an abstraction of reality and from that abstraction comes a certain degree of bias. Simply making decisions from one source of data is not enough, especially when we're not certain of the bias.

**How is data science making research more convenient and how may data influence the way we plan in future?**  
Typically, researchers may spend hours on-site observing the flow of human traffic. Theoretically, a data scientist can discover this with big data gleamed from cellular networks and social media instead. This not only makes research more convenient, but the huge quantity of data also allows the analysis to be conducted on a larger, more granular scale. Planners and other stakeholders can then see patterns over an entire day and zoom into specific time periods on demand. As a result, traditional ways of drawing up 5, 10, 15 year plans for huge parcels of land may give way to planning approaches that are more specific and intense.

To elaborate further, in some of the more experimental work I do, I study individual commute patterns to better understand how people travel, learn their lifestyles and discover

their preferences. Because data present to us an opportunity to observe, at very high level of detail, the activities that occur within our city, we can now be more nuanced and specific in the way we plan, design and manage urbanity. Crucially, this allows us to make less assumptions about the people and the environment we care and plan for.

**What is one thing you are working on that you are excited about?**  
I am fortunate enough to work on some research projects that look at how developments in ground sensing, simulation and artificial intelligence can come together to improve the quality of urban life. This is exciting for me as a scientist since it allows me to experiment with future city scenarios which may sometimes be too fictional or poetic to implement given real world time and resource constraints.

**If you had the time and resources, what is one pet project you may want to pursue?**  
I am interested to use data to enhance the experience of moving and getting around in Singapore. We can perhaps tap into data on cloud coverage, the position of the sun from Singapore's weather radar and figure out the heights of buildings to compute pathways around the city with the most shade. The calculation can change every 5 minutes and you can choose paths that are air-conditioned or not.

**What would you tell aspiring data scientists?**  
It takes a lot of hard work so stay curious. Try not to get distracted, always focus on the problem and look at it from different angles.





# Mining insights

Dr. Alvin Chua is part of URA's 15-man team in the digital planning lab set up in 2013 to exploit advanced digital planning tools and emerging technologies to transform the way planners work. "Digital planning tools can help us better understand the workings of the city through real-time data and enhance our ability to identify emerging concerns and trends to make better planning decisions," says Benjamin Chan, its director. The lab has been working across agencies, research institutes and the private sector to build up relevant and useful data and insights for use by policy makers and planners.

One of the first tools developed in-house, the e-planner, is now used widely across key government agencies. It is a one-stop, geospatial planning analytics multi-platform that enables planners to access and visualise over 100 data sets easily. Many different types of data and information layers can be generated at any time, from green spaces to demographics, opening up possible new insights for planners in considering the location of facilities, quality of spaces and other infrastructure and development needs.



## E-planner

The e-planner enables one to visualise the bigger picture and layer more intricate details and data sets at neighbourhood levels to make more robust decisions in shaping our urban landscapes and lifestyles.

### Childcare needs

How do planners determine whether there are enough childcare centres provided at the right locations? Information on the number of children in each neighbourhood and the childcare facilities available can help planners identify areas with more critical need for additional facilities and make provisions for them to offer relief for parents. This is being done with URA working with the Early Childhood Development Agency on this.

### Keeping Singapore cool

Temperatures are rising because of climate change. But Singapore is hotter than it should be because of urban heat island (UHI). Information on hot and cool zones across the island can help planners develop more specific strategies to keep Singapore's environment cool.

### Millennials and boomers

Whether millennials, boomers or a growing aging population, these will influence the way we plan and design the city, from provision of housing to schools and facilities. Information on population demographics island-wide and at town levels over time can help planners better anticipate and plan for current and future facilities and spaces to meet changing needs.

## Other tools



### GEMMA

This GIS-Enabled Mapping, Modelling and Analysis platform, has received a special achievement award for its innovative use of geo-analytics from the global mapping company Esri in July 2017. The platform enables planners from different agencies to compose different long term land use scenarios, analyse and simulate inter-dependent factors, from infrastructure facilities, to resource requirements to make better planning decisions.



### QUEST

The Quantitative Urban Environment Simulation Tool is a simulation software that can guide more climate sensitive urban planning and design with generation of wind, at different planning scales.



### Urban Systems Dashboard

An advanced dashboard that offers an integrated view of existing and upcoming infrastructures and developments for better coordination and decision making amongst planners and policy makers.



## From disrupted to disruptor

Whether it is rethinking the workplace, charting the future of farming or redesigning postal services of tomorrow, four disruptors are defying space constraints and show us nothing is impossible.

Writer **Justin Zhuang** | Photographer **Donn Tan**







**BEN GATTIE**  
CO-FOUNDER & CEO, THE WORKING CAPITOL, 33

The Working Capitol (TWC) resembles a hipster café instead of a Central Business District office. This is the future of offices, says Ben Gattie, who initiated this brand of co-working spaces with his sister, Saranta, in 2014.

**Redefining the work place**

“We wanted to change the gap between what developers have been building over and over again, and what the end user wants,” shares the soft-spoken Ben. By combining stylish offices, event spaces, restaurants and even a beer garden inside a row of shophouses at 1 Keong Saik Road, the Gattie’s built their first co-working space, which was named by *Forbes* magazine as one of the best in Asia in 2016.

The Working Capitol at Robinson is their latest iteration to cater to the growing “gig economy”,

where jobs are temporary and freelancing is the norm. Co-working spaces embody this new economy with their flexibility, and across 11-storeys of the newly rebuilt art deco tower at 140 Robinson Road are plug-and-play facilities such as unlimited Wi-Fi and access to printers and scanners, as well as a variety of workspaces that can be leased on a monthly basis. From hot-desking to dedicated duplex suites, as well as private cubicles to collaborative zones, this 55,000 square foot office works for everyone from solo entrepreneurs to firms that hire depending on the needs of a project.

**Creating a physical LinkedIn**

Beyond catering to the changing hardware of tomorrow’s businesses, TWC offers the software of “inclusive” and “inspirational” offices too, says Ben. Through “third spaces” such as a bar, a café and a gym, its members can socialise outside of work, while community

facilitators will also support the networking with relevant programmes at its dedicated events space. The goal is for TWC to become a “real-life LinkedIn” platform that brings together diverse groups of workers.

“Innovation doesn’t really happen unless you interact with other companies, different perspectives. That was the idea: how do we democratise the workspace – put the little guy on the same playing field as the big company – so they have things to learn from one another,” says the 33-year-old who studied and worked in the United States before returning to Singapore in 2009 to set up his own real estate development firm. “There is no point for companies to lock themselves in their ivory towers and hear their own gospel all the time.”

**The future worker**

Ben sees the future worker as one who seeks purpose in work, which is why attractive salaries are no longer enough to hire and retain talent. Companies need to care for their people beyond just focusing on their bottom line, and this means housing them in well-designed working environments. As more co-working spaces like TWC spread across Singapore, and network technologies proliferate, Ben envisions workers being able to work wherever they are.

“Buildings will not necessarily be developed for maximum profitability, but also have different end users in mind so the space can accommodate different types of activities and interactions,” he says.

**ERIC NG**  
GROUP CEO, APOLLO AQUACULTURE, 44

A tour of Eric Ng’s fish farms begins from his smartphone.

Inside his spacious Seletar West office, the owner of Apollo Aquaculture opens a live video stream of his staff monitoring fish tanks located across the city at Lim Chu Kang. A few taps and swipes calls up a feed of his client’s farm in China – managed thousands of kilometres away by his team right here.

**Rethinking farming**

Automated, networked, and even air-conditioned, Apollo represents the future of farming in Singapore. As the city’s available farmland continues to shrink with manpower constraints, Eric is part of a new wave of farmers supporting the city’s food supply chain through

creating high-tech, high-density, vertical farms.

While such technology is more commonly associated it with vegetable farming, Apollo has created a multi-storey system for rearing fishes and crabs. “It all started because of laziness,” says the second-generation owner of this farm that his late father started over four decades ago to rear ornamental fish. Tired of traditional farming’s back-breaking and repetitive ways, the only child began exploring automation after joining the family business in 1994. Subsequent visits to overseas high-tech farms convinced him to invest in research and development, a move that has resulted in his engineered water systems that are akin to high-rise apartments for fishes and crabs.

Compared to open water farming, this system produces higher yield in a smaller footprint, and rears fishes faster and healthier as the water quality is controlled with precision. Going high-tech has also made farming attractive to the new generation, says the affable 44-year-old. He recounts how parents of potential interns used to visit the farm as they were worried their children would be working laboriously under the sun.

To their surprise, Apollo’s employees were staring at computer screens inside offices and working at laboratories with cutting-edge tools instead. “Technology enables succession. If you look at my team, most of them are very young.”

**Farming free of land constraints**

Such sustainability is also how farming can survive in cities, says Eric. Unlike traditional fish farms that need to be near the coast, his farms can operate anywhere, even in landlocked countries. Such mobility is enhanced by Apollo’s modular and easy-to-assemble farms, a feature designed in response to Singapore’s short land leases. “Today, all the coastal lines are expensive areas for residential, condo and shopping malls facing the sea. I don’t think in the future, these will be available for farming,” he says. Freed of conventional land constraints, Eric envisions building his farms near cities so as to reduce logistics costs. This will mean affordable and fresh seafood at the doorsteps of city dwellers.

Earlier this year, Eric opened a high-tech farm in Brunei which produces live seafood that is flown into Singapore. He is also working to retrofit other farms in Singapore and Hiroshima, Japan, with his technology too. With the lease of his Lim Chu Kang farm ending in two years, Eric is now drawing up plans to tender for recently released farmland to build an 8-storeys, 16-metres tall, fish farm that can produce 10 per cent of Singapore’s needs.





**LEE POH WAH**  
CEO, LIEN FOUNDATION, 46

Publishing ideas for future preschools, organising a competition for death-related designs, and supporting an arts programme that includes children with special needs.

The Lien Foundation is a philanthropy with a creative bent.

#### Radical philanthropy

While most philanthropies are rooted in the social sciences, humanities and business, the Lien Foundation embraces art, design and technology to tackle issues in early childhood education, eldercare, as well as water and sanitation. “I like artists, architects, designers, and technologists because they are insurgents. They are able to immerse themselves in chaos and put some form and order,” says chief executive officer Lee Poh Wah. “It’s just like what Martin Luther King once

said, ‘Human salvation lies in the hands of the creatively maladjusted’.”

This belief in thinking differently is expressed in the foundation’s “radical philanthropy”, which seeks to understand the root causes of social issues and applying unconventional solutions. To do so, the foundation operates as an “adhocracy”, a lean six-person team that goes beyond the traditional role of a monetary sponsor by working closely with a network of partners to create a pipeline of projects. “It’s a plug and play system of management, ideas, resources, and partnerships,” says the 46-year-old who worked in real-estate investment and the civil service before joining the close to four decades old foundation established by the late Dr Lien Ying Chow.

Consider *A Different Class*, a series of 10 preschool concepts for underused spaces, that Lekker Architects created for the foundation in 2014. Besides distributing these ideas freely to the government and preschool operators, Lien

worked with voluntary welfare group, AWWA, and the agency for persons with disabilities, SGenable, to implement elements of these in Singapore’s first inclusive pre-school. Such prototyping helps the foundation evaluate their work and also convince others to adopt them, says the straight-talking Poh Wah. “I’m not in the business of running preschools. I don’t have land. I’m not a commercial entity. So the next best thing if you want to help envision the future of preschool spaces is to throw ideas out there and let people plagiarise.”

#### Realising everyone’s potential

A feature of the foundation’s many projects is also a multidisciplinary approach which Poh Wah says is key to tackling complex issues today. “The approach is like bao bak chang [wrapping a glutinous rice dumpling]. You need to wrap a comprehensive suite of services around the child and their family, or elderly.” A good preschool is useless in tackling poverty if the children are absent as their parents have unmet needs. This is why social workers and community partners are part of the foundation’s Circle of Care programme. Similarly, Lien’s recent initiative to build gyms for the elderly, Gym Tonic, led to training sports therapists about the new pneumatic equipment, working with IT consultants to gather usage data, hiring researchers to measure the gym’s effectiveness, and even branding the initiative to encourage take-up.

Underlying the foundation’s efforts is the belief that cities of the future needs world class social services too, say Poh Wah. This means ensuring every individual – children, elderly, or persons with disabilities – can reach his or her full potential in a diverse society. Of particular significance is the need to develop a sense of self by equipping all children with the skills of reflection, relationship building, and resilience.

**LAI CHANG WEN**  
CO-FOUNDER, NINJA VAN, 30

Lai Chang Wen hates opening his mail box.

The co-founder of last-mile logistics company Ninja Van prefers emails over letters, and says the standardised mail container every household and business has in Singapore is obsolete with the increasingly pervasiveness of e-commerce today.

#### Postal system of tomorrow

“Mailboxes have been irrelevant for the longest time,” says the chief executive officer of a company famed for using algorithms and technology to enable next-day door-to-door delivery of packages

in Singapore. Driven by its customer’s demands for cheaper and more convenient ways of delivery, Ninja Van is now building a postal system for tomorrow: a city network of automated parcel lockers and brick-and-mortar shops that function as post offices too.

“Can you build post offices all around and let people collect? You can. That doesn’t need technology, you just need to invest and have a rather inefficient use of space,” says the 30-year-old who wears his unconventional thinking in the form of a polo shirt, bermudas and slippers in the office. “But with technology, you can look at real life assets and make them multi-use.”

For instance, Ninja Van deploys a smartphone to guide traditional retailers on how to handle packages like post offices instead of having to train them. And while the company owns a fleet of delivery vehicles and drivers, it can also crowd source a reserve fleet of part-timers – including taxi drivers and even other startups – during unexpected spikes. In these ways, Ninja Van is building a network of “moving convenience stores” to make the movement and payment of goods seamless in Southeast Asia. And in just three years, the startup has expanded its operations into Malaysia, Thailand, Philippines, Vietnam and Indonesia too.

Beyond disrupting logistics, e-commerce is also redefining consumption, says Chang Wen. This calls into question the future of Singaporean’s favourite hangout, the shopping mall. “The face of retail will change a lot and that will affect a lot of retail mixes and neighbourhood shopping malls. How do you plan residential around a commercial mall? What should a commercial mall be like?” he says. “I won’t say retail is dead. Retail’s function is very different.”

#### Leveraging technology for real problems

Despite venturing into logistics with no prior experience, Chang Wen says he was hungry to learn, a quality vital to survive the future. “It’s important to not be a know-it-all but a learn-it-all,” says the former derivatives trader who left to start a made-to-measure menswear brand before realising the bigger problem to tackle was e-commerce logistics. “We are all in industries we never worked before. The key to getting things done is to accept that you make mistakes, but to pick yourself up and learn very quickly and try new things.”

Chang Wen adds that companies need to use technology not just as an optimiser to run business more efficiently, but as an enabler of new opportunities and markets. After all, it’s not just about doing something better, but doing what others cannot. This will define paradigm shifts in many industries with the ubiquity of technologies today.



Opposite (Top) | Art lessons held at the Kindie Garden Inclusive Preschool run by AWWA. Opposite (Bottom) | Senior users of Gym Tonic enjoying the facilities within an eldercare centre. Photo Credit: Lien Foundation



# Urban activism is on the rise

5 activists share their passion for making our city better.

Writers **Michelle Ng** and **Michelle Lee**  
Photographer **Robin Thang**



## Designing our city with youths

It was, strangely enough, trees that inspired Australian architect Katherine Murray to educate local youths about the city. “I couldn’t believe how beautiful the Ayer Rajah Expressway was when I first landed in Singapore 10 years ago. It just struck me how these incredible trees along the side of the roads were intentionally planted there for exactly this response,” she recalls. Stories like these fascinate the 44-year-old. And, having four young children of her own, she has bridged her personal and professional life to teach kids the basics of city planning. Her first major urban design workshop was part of URA’s second annual Urban Planning Festival held in March 2017 attracting more than 1,000 students on the intricacies of urban planning and design.



## Why is there a need to engage youths?

Cities change all the time, and everyone has a role to play. It’s not just about the big decision makers; they’re now looking to the population to see what people want, and how people use and engage cities. Engaging youths can teach them to see the city in a new, unfamiliar light, be active citizens and acquire problem-solving skills. And with these skills, who knows – the kids today might build an even better city tomorrow.

## Why is design thinking used in your workshop?

It’s a very accessible way of thinking and of problem solving. It forces you to think about the end-user, about the people.

## What is one that that impresses you about this city?

The way Singapore has managed to combine a high-density design with diversity to become a ‘City in a Garden’ is incredible.

*Go to Katherine’s twitter feeds @\_youngurbanists for interesting musings for 8 to 18 year olds to think, talk and explore cities. More information on URA’s student programmes can be found at <http://facebook.com/CUBESStudentWorkshop/>*



## Delving into Bukit Timah Railway Station’s past

Assistant Professor Yeo Kang Shua of the Singapore University of Technology and Design believes that “buildings undergoing conservation are very much like books waiting to be read”. It is on this premise that he is approaching the study of the conserved Bukit Timah Railway Station along the Rail Corridor “with no preconception”. An expert in architectural conservation, he has been involved in restoration projects like the Yueh Hai Ching temple and St Andrew’s Cathedral. This time, he is leading a group of 31 students from Architecture and Sustainable Design documenting the social and architectural history of the station. URA initiated the partnership with SUTD to delve deeper into the history of the station and enable students to play active roles. This is part of the students’ curriculum to gain hands-on learning and a deeper appreciation for heritage buildings. Following the completion of the master plan for the Rail Corridor, URA is now developing a 4 km stretch from the station to Hillview Road. Undergraduate Mok Jun Wei is excited about the project that uses photogrammetry techniques and 3D model illustrations and even examines construction methods used for the station.

## What do you hope to achieve from the study?

**Kang Shua:** Through the process of documenting the station, I hope students can learn to be more perceptive of their environments and along the way, learn about construction methods and conservation strategies.

**Jun Wei:** In our proposal after studying the site, we hope to re-adapt the existing infrastructure and integrate the historical site as part of the neighbouring residents’ lifestyles. This will allow the public to see the value in the preservation of our heritage.

## What kinds of uses and experiences do you want for the station and corridor?

**Kang Shua:** Personally, I would like to see minimal intervention and a light touch for the station when it undergoes restoration. It has a waiting area which could continue to be used as a rest area. As for the corridor, it has always been about bringing people and goods from point to point by cutting through the island of Singapore. The idea of the “section” of Singapore from the perspective of a train commuter going through different landscapes (manmade or otherwise) is very interesting. It will be wonderful to be able to bring back such an experience.

## How do you think the community can continue to shape such spaces?

**Kang Shua:** As much as we want to tap into its potential to develop and provide the community with spaces for public use, we must be mindful of how we can also protect it. With historical references to guide us on its heritage and conservation, memories related to the railway line and structures can be preserved. It is a precious asset and active use of the space will ensures its longevity.





**Deepening place-making for precincts**

It is his love for the river and bringing together passionate individuals to shape its future that got Wilson Tan, the deputy chief executive officer of CapitaLand Mall Asia started on heading Singapore River One (SRO) from 2012, a private sector led group driving place making efforts for Singapore River. He believes it is stakeholders of the river that can bring out its best. He is part of a growing group of Singaporeans working closely with URA and other agencies in proactively place-managing key precincts. It is not for the faint hearted says Wilson, where place making involves a range of work like enhancing the physical environment of the place, improving its image and programming activities to ensure its viability. Wilson works with stakeholders like Rainer Tenius, general manager of Swissotel Merchant Court, who sees the value in collective efforts. “There is power when people come together,” he says.

**What are some of your proudest moments?**

**Wilson:** Turning Circular Road into a weekend car-free street. This was an idea from stakeholders along the road. It took some effort garnering support but now the road has

become a signature attraction in the weekends. We also started the annual Singapore River Festival from 2015 with 100,000 visitors in the first two editions and more than 80 stakeholders took part.

**What are some lessons learnt on place-making?**

**Wilson:** You must be able to identify key priorities for the precinct and articulate the shared vision well to galvanise support from the stakeholders along the river and partner agencies. Maintain an open channel of communication wide enough to receive different perspectives. The place-making team must be authentic and willing to go the distance for the greater good of the community. Focus on small wins to show that these can make a difference for the precinct.

**What role do stakeholders like yourself play for Singapore River?**

**Rainer:** The stakeholders in any precinct are doing more or less well individually, but they can do so much better if they join forces and leverage on synergies so everyone benefits. We all play crucial roles in upholding the Singapore River brand and ensuring it continues to be a desirable place to go to.

**Beyond the current voluntary approach, other cities are pursuing formal models like Business Improvement District (BID) where all stakeholders pay for and drive key efforts? How can BID help with SRO’s efforts?**

**Wilson:** With a formalised approach, there is more certainty in putting in place a funding model that is sustainable to support SRO’s place management of the precinct. It brings greater stability to the planning process, be it timeline or people resources. If SRO adopts a BID approach, we will be able to cater for activities that are larger in scale and financially sustainable. This allows SRO to plan in a longer term with more certainty. We can explore improving the infrastructure, implementing more robust marketing campaigns

and working with corporations to pursue longer-term collaborations, drawing more visitors to the precinct.

**Rainer:** A BID also ensures that all stakeholders in a particular precinct contribute to the goals together in terms of membership fee (no free-riding). A steady income is crucial for place-making of a precinct to be successful in the longer term.

**What is your advice for people keen to do place-making?**

**Wilson:** Be bold and courageous! The bonds that you create during this journey of creating a new future will be rewarding.

**Business Improvement District for Singapore?**

URA planners and other agencies have been working closely with precinct stakeholders to implement crucial place-making efforts in Singapore. In the last decade, more are coming out to take on active roles with several precincts managed by stakeholders for areas like Singapore River, Little India and Kampong Glam. However, the current voluntary approach is not sustainable with limitations in resources and funding. To continue to enhance and sustain our precincts and empower stakeholders further, URA is exploring more formal models like the Business Improvement District (BID) concept used in other cities that have significant results.

**5 things to know about BID**

1. It refers to a specific area where all major stakeholders come together to invest in and drive improvements and initiatives for the area.
2. It is established and run independently by the private sector, supported by legislation and funded by mandatory fees from property owners and businesses in the district.
3. It offers more definite support and commitment from stakeholders to ensure the success of a place.
4. It started in the United States and Canada in the 1960s and there are more than 1000 BIDs being pursued in cities around the world today.
5. A key example of BID’s successful impact is the Times Square in New York. The private group Times Square Alliance has transformed the space in the last 25 years. It now generates US\$110 billion of economic activities.





# #SINfromabove

Photographer Yeo Kai Wen unveil instagram-worthy drone shots of Singapore.

Writer **Sofiana Ramli** | Photographer Yeo Kai Wen

Kai Wen started dabbling in drone photography during his visit to the Arctic's Edge in Canada in 2014, where he chronicled the effects of climate change. As a freelance photojournalist, he is fond of telling stories and documenting how environmental issues affect humanity. His photographs have also been presented at various exhibitions, including *Singapore from Above*, a project that includes aerial images of green spaces, such as public parks and various heartland structures.

Kai Wen's shots display the careful planning of greenery and built structures such as roads, and how the two harmoniously come together in Singapore. "The geometry and shapes of our environment from the air is breathtaking," he says. "It tells the story of how mankind has shaped the landscape over time and how quickly spaces change in Singapore."

@sgfromabove

The architecture of the Singapore Science Centre was decided by a design competition organised by the Science Centre Board. With over 850 exhibits spread over eight exhibition galleries, it sees over a million visitors a year today.



1. VivoCity is the largest shopping mall in Singapore. Located in the HarbourFront precinct of Bukit Merah, it was designed by Japanese architect Toyo Ito. Its name is derived from the word "vivacity".
2. Ng Teng Fong Hospital looks like a collection of human organs from above. Named after Singaporean entrepreneur, Ng Teng Fong, the hospital is part of an integrated development together with the adjoining Jurong Community Hospital.







3. Nanyang Technological University is one of the three public universities in Singapore. Each hall of residence looks different from above, and Hall Six resembles a large octopus.
4. West Mall was opened in 1998, housing a mix of shops such as fashion, jewellery, gifts and specialty stores, cafes and restaurants.



# At a glance

We check out the latest events and happenings shaping the landscapes and neighbourhoods around us.

### More car-free streets for everyone

Thinking of organising street closures for charities or fund raising for persons with disabilities? Under the Streets for People programme, social enterprises, voluntary welfare organisations or charities can now benefit from additional seed funding. Check out <http://ura.sg/StreetsForPeople> or write to [URA\\_carfreezones@ura.gov.sg](mailto:URA_carfreezones@ura.gov.sg) to find out more!



### Urban Dialogue by Farrells

Curated by SKY YUTAKA, this exhibition by UK-based architecture firm Farrells, led by Sir Terry Farrell aims to promote discussion on the role of sensitive urban design during this period of rapid global urbanisation. Visit the exhibition to experience the different stages of urban design utilising various tools.

12 Oct – 12 Nov | Singapore City Gallery, The URA Centre, ground floor



### Growing more with less

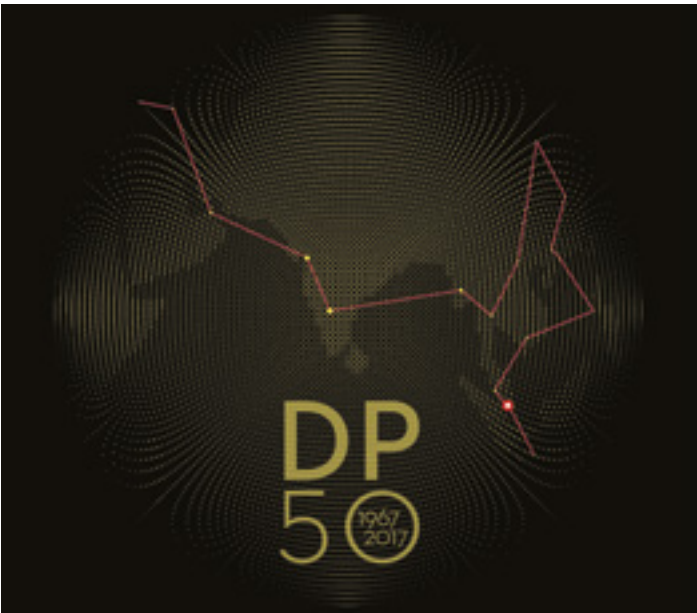
Will Singapore ever be self-sufficient in food production? As we march towards the future, this exhibition curated by Urban Lab will feature key players in Singapore's urban farming scene such as Kulhbarra, Sky Greens, Greenphyto and Apollo Aquaculture, introduce new urban farming technologies and paint the possibilities for urban farmers of the future. Read our interview with Eric Ng, Group CEO of Apollo Aquaculture on page 35.

4 Sep – 31 Oct | Singapore City Gallery, The URA Centre, ground floor

### DP Architects turns 50

8 subsidiaries, 17 offices and 3000 projects across 77 countries. Singapore-based DP Architects showcases 50 years of architectural explorations through their work in this exhibition, their design philosophy is built on a deep concern for the environment and human experience.

12 Aug – 29 Sep | Singapore City Gallery, The URA Centre, ground floor



### LOOP around the island

Joseph Nair tests out LOOP, a cycling app developed in collaboration between the Urban Redevelopment Authority and students from Singapore Management University. This journey planner and route tracker is designed for recreational and new cyclists. Read about his adventures on [Going Places Singapore](http://Going Places Singapore) [goingplacessingapore.sg](http://goingplacessingapore.sg)

### Re:Bench

"Re:Bench" is the third in the series of design competition which celebrates the story of the Singapore National Stadium. URA is inviting young designers to create benches using the seating planks of the stadium to enliven public spaces and inspire the community, selected designs will be fabricated and installed at public locations. Design themes can include sustainability, communal spaces and sense of community.

Email your entries to [AUDE@ura.gov.sg](mailto:AUDE@ura.gov.sg) with the subject "Re:Bench Submission" by 30 Nov 2017, 2359hrs





What will our work/learn spaces of the future be like?  
Read more on page 14.

