



# BUILDING A LIVEABLE CITY

CITIES ROUNDTABLE REPORT 2017





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A common challenge faced by cities today is how to achieve higher standards of living, while managing urban expansion, without depleting our natural resources.

This is especially important for Singapore, since we are a small city-state with very limited land and natural resources. As our population becomes better educated and more diverse, it will be ever more difficult to meet their different needs within the means that we have.

Collaboration between government agencies and research institutions will be vital in devising creative solutions which optimise the use of resources, so as to nurture resilient and sustainable cities for the future.

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**KHOO TENG CHYE**  
EXECUTIVE DIRECTOR  
THE CENTRE FOR LIVEABLE CITIES



## ABOUT THE CITIES ROUNDTABLE

The Cities Roundtable is an annual event that brings researchers and policymakers at the frontier of urban sustainability together to tackle urban challenges through an integrated, multi-disciplinary approach. It also serves as a platform to catalyse collaborations between Government Agencies and Research Institutions for the co-creation of practical solutions to urban challenges.

2017 marked the fifth edition of Cities Roundtable, and was attended by 112 participants from 18 government agencies and 24 research institutions.

This year, the Roundtable explores five themes identified as key research and development areas:

1.

### LIVEABLE CITIES

*How do we create cities with a high quality of life that are efficient, green and inclusive while meeting the diverse needs of a growing population?*

2.

### URBAN ANALYTICS

*How do we develop capabilities in big data and simulation technology to improve the way we plan and design our cities?*

3.

### CREATING SPACE

*As an island city state where land is a constraint, how can we create new space or optimise used space sustainably and innovatively?*

4.

### ADVANCED CONSTRUCTION AND INNOVATION

*How do we innovate in construction and maintenance to be more cost-effective, less labour-intensive and more durable?*

5.

### BUILDING RESILIENT COMMUNITIES

*How do we take a systems approach to ensure an urban environment that is safe, reliably maintained and highly resilient to future urban challenges?*



## INTRODUCTION

Some useful directions in research can be drawn from the Cities Roundtable 2017. These approaches can be summarised as:

- Informing research through the use of technology and digital tools
- Using pilots and scaled-up testbeds
- Collaborating with communities

### INFORMING RESEARCH THROUGH THE USE OF TECHNOLOGY AND DIGITAL TOOLS

Technology and digital tools can help us think laterally and move beyond conventional wisdom and business-as-usual practices. For instance, by using remote sensing technologies such as Light Detection and Ranging or LIDAR, we could identify emergent benefits from urban greenery such as greater resilience against flash floods, better shading from direct sunlight and more comfortable temperatures for our urban environment. This gives us the opportunity to design and integrate streetscapes and vertical green ecosystems to make cities even more liveable.

Digital tools, such as GIS-Enabled Mapping Modelling and Analysis Platform or GEMMA, give us the opportunity

to verify many of our common assumptions by bringing together different sets of data on a common platform. This means that different stakeholders can see urban challenges holistically and find balanced decisions for the common good. Technology also enables us to build a more democratic collaboration in the planning process; for instance, the Tangible Interactive Modelling prototype simplifies the technical aspects of the urban planning process, allowing citizens to participate in the discussion.

## USING PILOTS AND SCALED-UP TESTBEDS

How do we know if the outcomes of research will work well when implemented? Pilots and scaled-up testbeds can help not only to establish proofs-of-concept, but also help refine research and tweak solutions on the ground. For example, JTC piloted a facility management system using the internet of things. The pilot showed significant improvements in efficiencies leading to the expansion of the pilot to all JTC buildings. During the capstone event for Singapore's SG50 celebrations, AAL (SUTD) collaborated with the Centre for Liveable Cities to introduce a pavilion for the Future of Us exhibition based on a prototype design. Using computer-aided design and manufacturing, the project was scaled-up and completed in six months. Today, the pavilion is a testament that it is possible to build beautiful customisable structures without incurring additional time, cost or material wastage.

## COLLABORATING WITH COMMUNITIES

Despite the benefits of innovative solutions, the introduction of new sustainable and liveable technologies can be disruptive and inconvenient for the resident. HDB's Greenprint pilot projects show us the power of engagement and collaboration in mitigating these factors. Besides tailoring liveable and sustainable solutions to provide a seamless improvement for the community, HDB worked with the community to encourage them to be active participants of greener living. This holistic approach is instructive as it reminds us that in order to unlock the benefits of innovation, social practices need to be developed alongside technological advancements.

Collaborating with stakeholders could also yield innovative urban solutions. Working with students, agencies and stakeholders, CLC's Reimagining Orchard Road offers a glimpse into the rich pickings of collaborating with communities. Singapore's Orchard Road could model successful shopping streets that have multiple social layers, becoming a place where people not just shop, but also engage in meaningful bonding with nature. NUS -Deltares, in its initial scoping phase of a project on Urban Resilience, already tries to establish collaborative communities of practice in this realm – again emphasizing the power of collaborations to achieve holistic outcomes and build communities in the process.



# BIG IDEAS FOR RESEARCH





# INFORMING RESEARCH THROUGH THE USE OF TECHNOLOGY AND DIGITAL TOOLS

Technological advancement and new digital tools have exponentially expanded our capabilities to improve city life. Tools such as the *tangible interactive urban modelling platform* uses Lego bricks to unlock the black box of technocratic knowledge for the average resident. Besides democratising expertise, urban experts also stand to gain from new digital tools. *GEMMA*, for instance, have brought different urban planners together by presenting multiple datasets on a single platform. Similarly, LIDAR technology enable a more holistic understanding of urban greenery, which enriches the discussion on green replacements.

PROJECT NAME: ECOSYSTEM SERVICES IN URBAN LANDSCAPES  
PRESENTED BY: PROF. DR. PETER EDWARDS  
SUPPORTED BY: FUTURE CITIES LABORATORY



# DO TREES REALLY MAKE OUR CITIES COOLER?

# DO TREES REALLY MAKE OUR CITIES COOLER?

## *The Big Idea:*

***Quantify the forest or overall effects of greenery, not just the trees.***

*Future Cities Laboratory is studying the ecosystems service provision of urban vegetation to quantify their benefits and incorporate them into better urban design.*

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The next wave of tropical green cities will do more than include trees: they will replicate a rainforest environment. Researchers at the Future Cities Laboratory (FCL) are making an important first step in this vision by quantifying the 'service' value of urban vegetation.

A rainforest environment could provide "ecosystem services" to a city, with substantial benefits. For example, rainwater often leads to flash floods since 65% of rainwater in cities results in runoff. In contrast, rainforests only experience 15% rainwater runoff, as rainwater is dissipated through as trees transpire or water is absorbed by the ground. This suggests that if we can replicate rainforest conditions using urban greenery, cities could become more resilient against flash floods.

Remote sensing technologies, such as Light Detection and Ranging (better known as LiDAR), offer new opportunities to realise this vision. Airborne LiDAR lets planners accurately accumulate discreet data, such as the height and type of trees and the density of greenery. At present it is not possible to identify the growth rates of certain trees, as early data of its height is not accurately captured. However, tree growth could be determined by comparing LiDAR images over time. Furthermore, because LiDAR is non-intrusive, it would

be possible to study trees along expressways without disrupting traffic. It could also provide information on the amount of light at a viaduct, to help identify the best type of tree to plant under those conditions.

Besides airborne LiDAR, terrestrial LiDAR captures data from the ground to create 3-dimensional images. These could be used to quantify the ecosystem services provided by vegetation incorporated in green buildings. In recent years, green buildings -- such as the Bosco Verticale -- have featured impressive vertical forests that are ecosystems in their own right.

However, LiDAR technology is expensive both to collect and to store, so cheaper alternatives are used for smaller scale studies. For instance, FCL researchers used Google Maps to identify the impact of tree shades along pedestrian paths in Singapore. It was found that 13% of solar radiation was blocked by shading and 70% of that shade came from green canopies. Further research was taken to match the most commonly used streets with street greenery, identifying spots that could more effectively provide shade for pedestrians.

With the rise in digital planning tools, the quantification of ecosystem services will enable planners to better understand the trade-offs of urban development and incorporate ecosystem benefits into urban design.



“

...[W]hen we allocate a parcel of land for a particular purpose, I want to know what are we losing in terms of ecosystem [services] that we need to replace.

”

**PROFESSOR PETER EDWARDS**  
DIRECTOR AND PRINCIPAL INVESTIGATOR  
SINGAPORE-ETH CENTRE, FUTURE CITIES LABORATORY

PROJECT NAME: INTEGRATED CITY PLANNING (ICP)  
RESEARCH PROGRAMME  
PRESENTED BY: HUANG ZHONGWEN, SENIOR PLANNER,  
URBAN REDEVELOPMENT AUTHORITY  
SUPPORTED BY: URBAN REDEVELOPMENT AUTHORITY



# HOW DO WE AVOID THE DANGERS OF 'COMMON SENSE'?

# HOW DO WE AVOID THE DANGERS OF 'COMMON SENSE'?

## *The Big Idea:*

### ***Unpacking 'common sense' for planning by using digital tools.***

*Through digital planning tools, the Urban Redevelopment Authority (URA) aims to have a more responsive planning system to understand the complex webs of inter-dependencies, and to consider a wider range of planning scenarios and planning options to formulate urban solutions for the future.*

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In urban planning, 'common sense' is often a misnomer for black boxes of assumptions that hinder deeper levels of cooperation. Digital planning tools help us unpack the assumptions of 'common sense', using big data analytics and modelling. For instance, in a study by URA, it was found that students travel to 'established schools' from all over Singapore, while students from less 'established schools' arrive at school from neighbouring areas. After establishing this fact, it was possible to bring different stakeholders together to study transport patterns. For the first time, planners could deep dive into the actual public transport patterns of student pass holders.

One reason established schools attract students from all over Singapore is because of how places in schools are typically accorded. More established schools typically give more weight to school affiliation instead of its distance from homes. Intuitively, it

may be tempting to reverse this policy to reduce travelling time for students. However, this could result in schools in different towns being either under- or over-subscribed. With digital planning tools, many layers of data can be simultaneously analysed to model possible consequences and unpack assumptions. URA's GIS-Enabled Mapping Modelling and Analysis Platform (GEMMA), for instance, provides access to a rich set of map-based data, which includes land use, transportation and demographic data, to help head off unforeseen consequences.

The widespread use of digital planning tools will boost the capabilities of planners to locate suitable sites for housing, amenities and areas for conversion to car-lite districts. In time, we will move away from being constrained by the black boxes of common sense and begin to expand the boundaries of our imagination.



“

What we are really interested is to be able to translate the ideas, concepts, prototypes, that derive from research and translate [it] into real world applications and practice.

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**HUANG ZHONGWEN**  
SENIOR PLANNER  
URBAN REDEVELOPMENT AUTHORITY

**PRESENTER:**

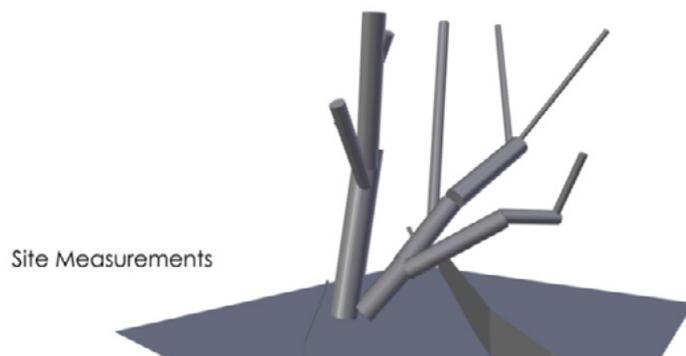
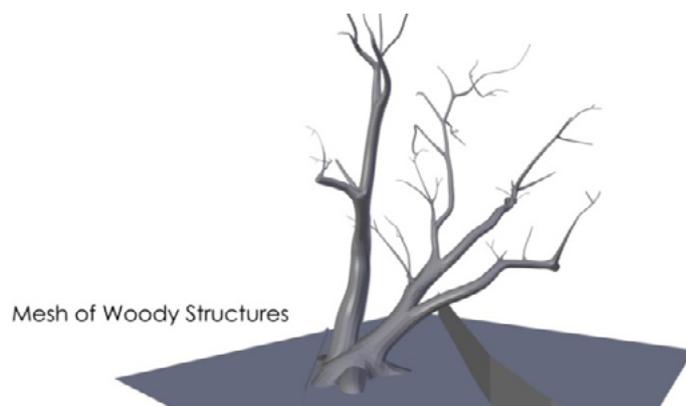
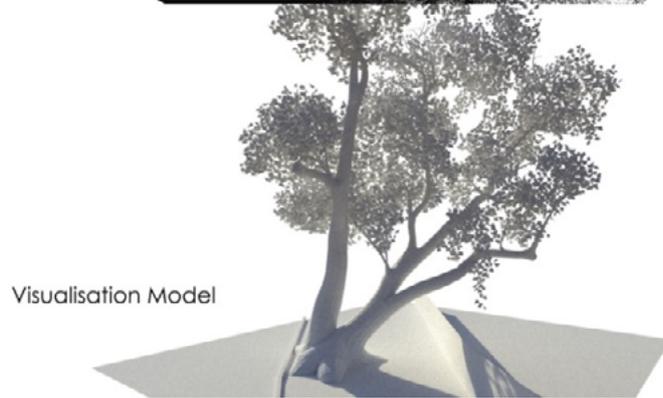
**DR ERVINE LIN**

RESEARCHER, CENTRE FOR  
URBAN GREENERY AND ECOLOGY,  
NATIONAL PARKS BOARD

Dr Ervine Lin is the lead researcher on the collection of 3D geospatial data to explore the potential of 3D representation of the physical world for urban ecological planning.



## 3D Tree



3D modelling of a heritage tree from mobile LiDAR data provided by SLA. LiDAR data itself, while immensely useful, still requires post processing for the data to be converted into other formats for different purposes. Here, other than a realistic representation of the tree, a mesh of the tree's woody structures is traced out manually to feed into structural simulations. This allows us to accurately design for external supporting structures, or recommend a pruning strategy in order to keep the tree upright for as long as possible.



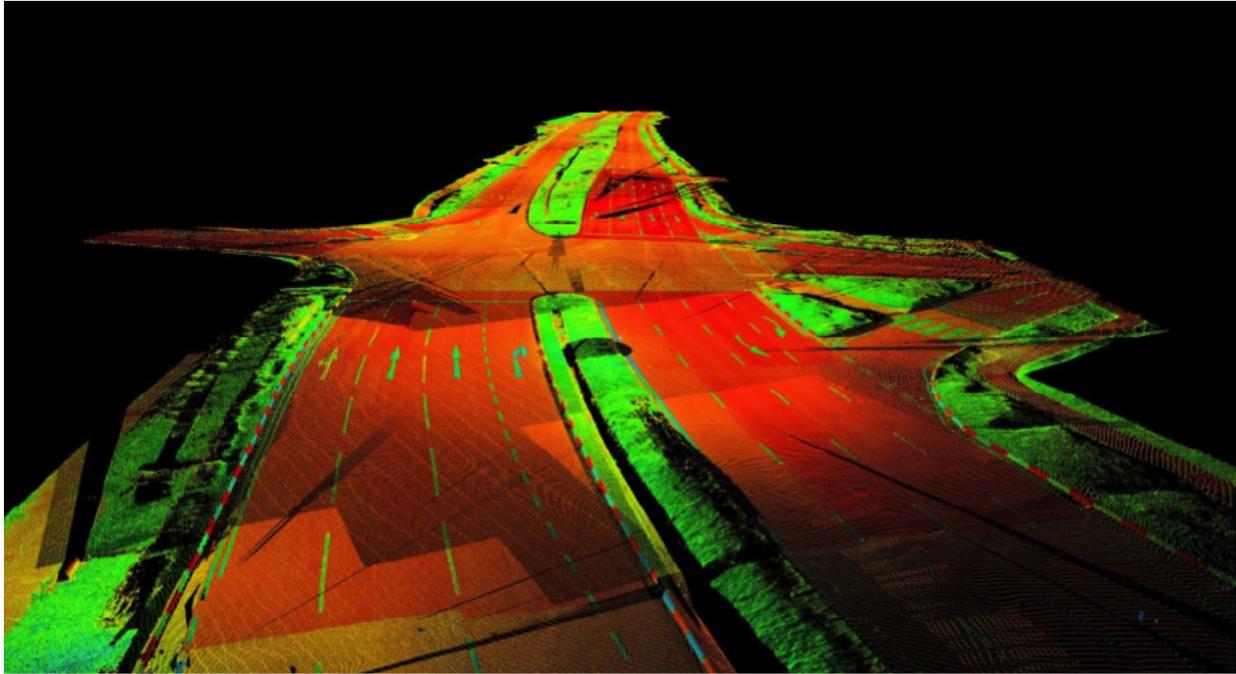
**PRESENTER:**

**DR VICTOR KHOO**

DEPUTY DIRECTOR, LAND SURVEY  
DIVISION, SINGAPORE LAND  
AUTHORITY (SLA)

Dr Victor Khoo leads the 3D  
National Mapping project,  
which captures street level data  
using mobile mapping systems  
to create 3D models of all road  
infrastructures in Singapore.

## 3D National Mapping Project



Singapore Land Authority's intensity LiDAR data of one of Singapore's roads highlight some potential uses of the 3D national mapping project, such as terrain and road profiling.

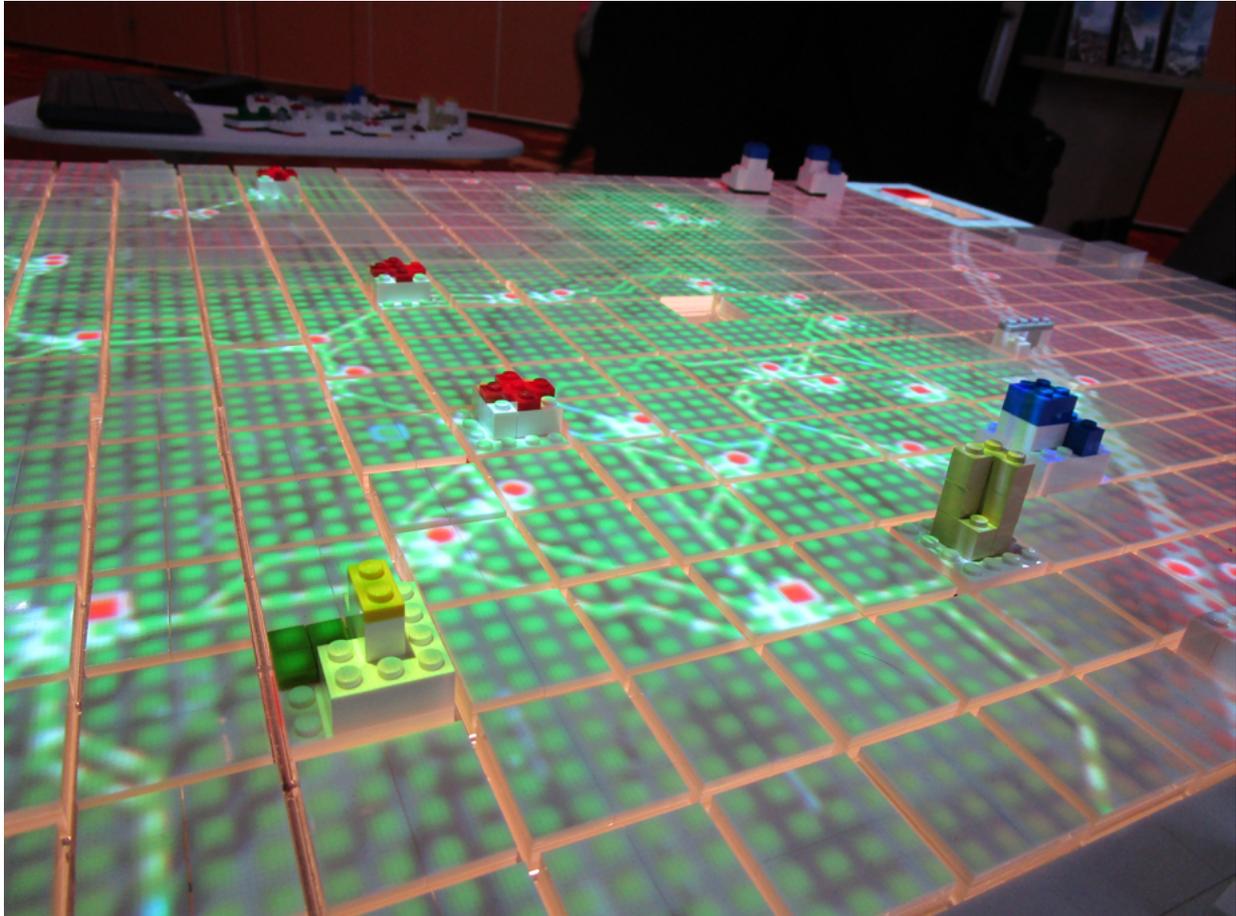
**PRESENTER:**  
**ZHOU YIMIN**  
CENTRE FOR LIVEABLE CITIES,  
RESEARCHER

Zhou Yimin is the lead researcher on an urban planning prototype, the *Tangible Interactive Urban Modelling*: a tool for collaborative and participatory Urban Planning.

The prototype was featured at the World Cities Summit 2016.



## Tangible Interactive Urban Modelling Platform



The *Tangible Interactive Urban Modelling* platform uses Lego bricks to enable both experts and people with limited technical expertise to better experiment with, contribute to and appreciate urban planning processes.

CLC is planning to develop this platform further, for use in the test-bedding of urban solutions at the Western Industrial Area, as well as the car-lite initiatives in the Jurong Lake District.



# USING PILOTS AND SCALED-UP TESTBEDS

The success of a pilot is a strong proof-of-concept for a wider application of the solution. For example, the cost of managing facilities has grown with the introduction of new technologies such as solar roofs and greywater management systems. JTC corporation piloted an integrated smart estate and building operations system that reduced costs by capitalising on the internet of things. From its pilot, its impressive results eliminated the inertia of change to replace traditional processes with automated ones.

Pilots are very effective in changing pre-existing notions that inhibit better solutions. For instance, the pavilion for the *Future of Us* exhibition transcended the perceived limitations that it is not possible to build beautiful structures without additional cost. The piloting of horticultural therapy also challenged ideas on well-being by showing that participating in greenery have greater benefits than previously imagined.

PROJECT NAME: EFFECTS OF HORTICULTURAL THERAPY ON THE MENTAL HEALTH OF ASIAN ELDERLY

PRESENTED BY: ANGELIA SIA, DEPUTY DIRECTOR, CENTRE FOR URBAN GREENERY AND ECOLOGY (RESEARCH), NATIONAL PARKS BOARD

SUPPORTED BY: GARDENS BY THE BAY AND NPARKS (CUGE)



# HOW DO WE DESIGN HAPPY, HEALTHY PLACES?

# HOW DO WE DESIGN HAPPY, HEALTHY PLACES?

## *The Big Idea:*

***Cultivate a community of elderly horticultural enthusiasts.***

*The National Parks Board is studying the efficacy of horticultural therapy in improving the psychological health, cognitive functioning and social connectedness of the Asian elderly.*

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Do you wish to be happier? Try taking a walk in the park. Well-established studies have found that greenery can have positive effects on the human psyche, from providing relief from mental exhaustion to lifting moods and improving the immune system. The urban elderly, who are particularly vulnerable to loneliness and declining health, could benefit from greenery's effects on wellbeing. To test this idea, the Centre for Urban Greenery and Ecology (CUGE) at the National Parks

Board (NParks), conducted a randomised controlled trial to explore the effect of horticulture on the elderly. The trial found that the elderly who participated in various horticultural activities were healthier, happier and felt less lonely.

NParks has since developed a network of therapeutic gardens for the enjoyment of the elderly.



**PRESENTER:**

**ANGELIA SIA**

DEPUTY DIRECTOR,  
CENTRE FOR URBAN GREENERY  
AND ECOLOGY (RESEARCH),  
NATIONAL PARKS BOARD

Angelia Sia is one of the researchers studying the effects of horticultural therapy on the mental health of elderly Asians. The project is being conducted in collaboration with the National University Health System, led by Professor Roger Ho and Professor Kua Ee Heok.



“

[T]he issue is how do you change people's behaviour? Between your planning and setting out all the right spots, how you actually get people to change is really the marriage and combination of the two.

”

**PROFESSOR CHAN HENG CHEE**  
AMBASSADOR-AT-LARGE AND CHAIRMAN,  
LEE KUAN YEW CENTRE FOR INNOVATIVE CITIES  
SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

PROJECT NAME: FUTURE OF US PAVILION  
PRESENTED BY: THOMAS WORTMANN, ADVANCED ARCHITECTURE  
LABORATORY, PHD CANDIDATE AND RESEARCHER  
SUPPORTED BY: CENTRE FOR LIVEABLE CITIES



# HOW DO WE BUILD FOR THE FUTURE?

# HOW DO WE BUILD FOR THE FUTURE?

## *The Big Idea:*

***Computer-aided design and digital fabrication are revolutionising the construction industry***

*The Advanced Architecture Laboratory (AAL) at the Singapore University of Technology and Design studied data structures and automated digital workflows to integrate architectural design, environmental performance, digital fabrication, assembly and automation in an efficient manner.*

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Must there always be a trade-off between quality, speed and cost? AAL is challenging such conventional wisdom with digital workflows and digital fabrication. Using 11,000 unique panels, the team at SUTD was able to build the 60 metres by 70 metres pavilion for SG50's capstone event, the Future of Us exhibition, in a record six months from design to completion.

Unbeknownst to many, the pavilion was a late addition to the project. By then, the Future of Us exhibition had already decided to erect 4 domes to house its displays. This meant that the pavilion had to be designed to match the structure of the exhibition, making the project more complicated than usual. SUTD's team were able to meet

these stringent requirements using CAD CAM (computer-aided design and computer-aided manufacture). The computation system made it easy for the designer to intervene and change the geometry of the structure, for instance to accommodate panelling if necessary.

The AAL team used complex tile sets with individual geometry without requiring skilled labour on site. This is due to the innovative way each tile is designed to repeat and fit together in only one way, preventing mistakes in the building process. Each element is also numbered and labelled, clearly indicating how it is to be put together, making it possible to build without depending on drawings on site.

**PRESENTER:**

**THOMAS WORTMANN**

ADVANCED ARCHITECTURE

LABORATORY, PHD CANDIDATE

Thomas Wortmann was a project architect and computational design specialist in the Future of Us Pavilion team led by Prof Thomas Schroepfer, Director of Advanced Architecture Laboratory (AAL) at SUTD.





“

[T]here is an almost dangerous conventional wisdom that construction productivity means the design must be simple, standardised, boring so that it can be built quickly.

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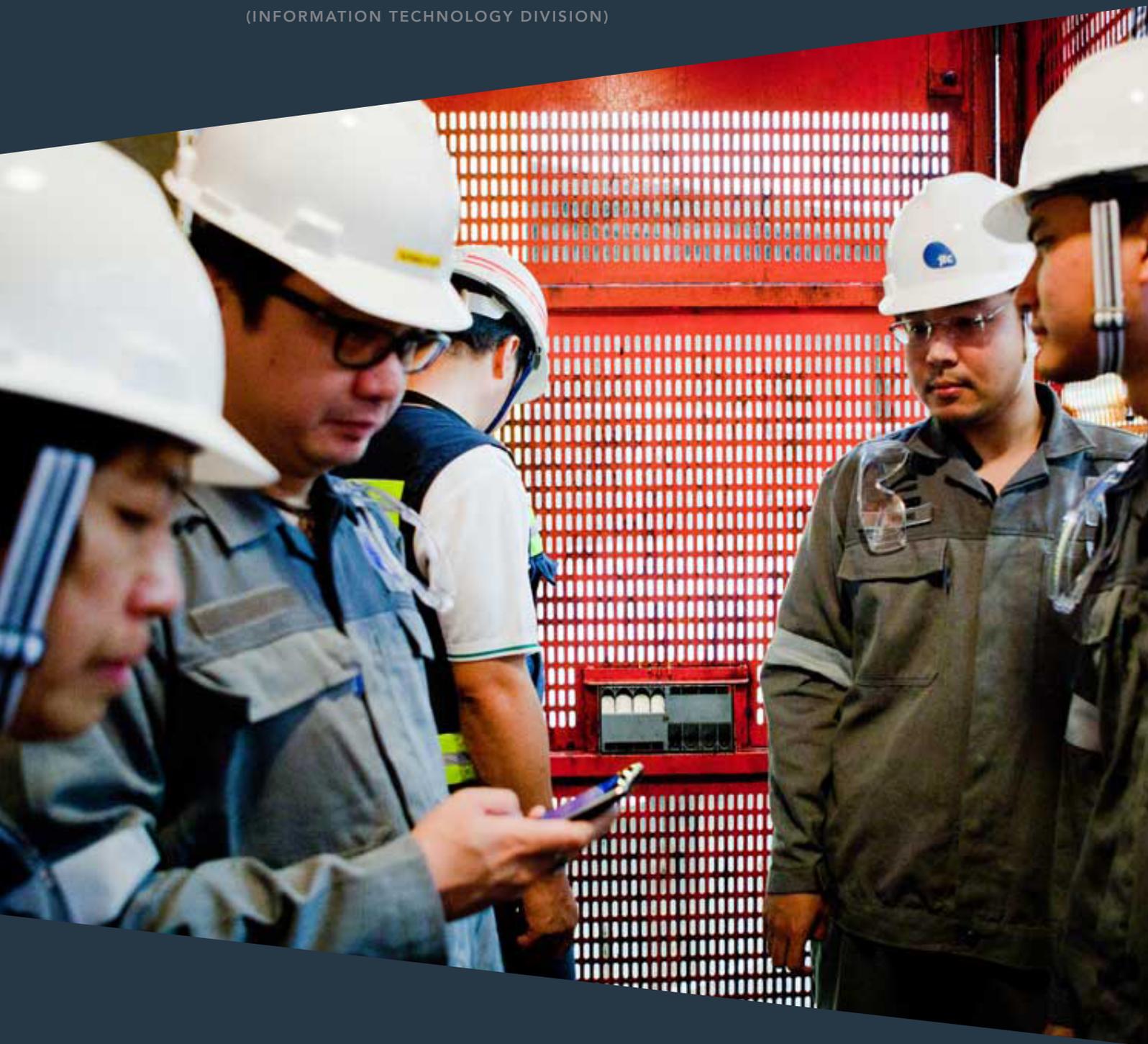
**KHOO TENG CHYE**  
EXECUTIVE DIRECTOR  
CENTRE FOR LIVEABLE CITIES

## Pavilion for the future of us exhibition



The pavilion for the Future of Us exhibition modulates daylight and wind to create a comfortable outdoor climate and visual appeal using light and shade. This is achieved with digitally prefabricated aluminium panels of individual geometric patterns and sizes.

PROJECT NAME: INTEGRATED SMART ESTATE AND BUILDING  
OPERATIONS SYSTEM (JOPS)  
PRESENTED BY: SIEW YIM CHENG, CHIEF INFORMATION OFFICER,  
JTC CORPORATION  
SUPPORTED BY: JTC CORPORATION  
(INFORMATION TECHNOLOGY DIVISION)



# HOW DO WE USE THE INTERNET OF THINGS FOR OUR BUILDINGS?

# HOW DO WE USE THE INTERNET OF THINGS FOR OUR BUILDINGS?

## *The Big Idea:*

### ***Digitising building maintenance for more efficient, smart buildings***

*JTC has created a facility management system that leverages on sensors, data analytics and machine learning for sustainable growth.*

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Despite the growth of sensors and advance indicators in buildings, most building services are still maintained with traditional methods. Facility managers continue to depend on fixed-schedule maintenance, manual inspection and trouble-shooting, and the replacement of parts only upon failure. This is not sustainable for many reasons, ranging from high operating costs to lower tolerance for downtime. JTC piloted a facilities estate management system for three of their buildings to improve building services by using data analytics, machine learning and the Internet of Things.

JTC's Facilities Estate Management System sought to improve the monitoring, analysis and optimization of its facilities. Traditional facilities management is very labour intensive. This is because each building is managed individually and cannot benefit from economies of scale. Using an integrated system, JTC's system achieved better

productivity by responding swiftly to incidents and detecting faults early through analysis. Quality control was improved, with repairs being assessed immediately.

JTC's system also optimised its building operations by replacing scheduled maintenance with predictive maintenance, reducing labour needs and increasing the useable lifespan of equipment.

The pilot study reported 15% annual energy savings and a 20% increase in productivity. The new system could not only properly capture, diagnose and analyse faults, but also detect previously undiscovered faults. Work processes improved, with an increase in efficiency since it was now possible to quickly and efficiently prioritise faults based on their severity. The success of the pilot gave JTC confidence to implement the system for all 39 JTC buildings by the end of the year.



**PRESENTER:**

**SIEW YIM CHENG**

CHIEF INFORMATION OFFICER,  
JTC CORPORATION

Siew Yim Cheng led the development of an integrated smart estate and building operations system (JOps) at JTC Corporation. JOps leverages on building equipment sensors, internet of things, data analytics and machine learning to drive the optimisation of equipment operations, and enable predictive facilities management (FM) instead of the usual scheduled FM. This has led to greater energy savings, better productivity and efficiency for the facilities management teams and the scaling up of the FM industry in general.



“

[F]or maybe 80% of the thing (maintenance issue), it is a simple thing and you just sort of read the value, you're done. What if it isn't the 80% of the things and it takes time?

”

**STEVEN MILLER**  
VICE-PROVOST (RESEARCH)  
SMU SCHOOL OF INFORMATION SYSTEMS

## Integrated Smart Estate and Building Operations System (JOps)



JTC’s integrated smart estate and building operations system allow for building level analysis, which would show where the faults are and the equipment affected. This allow for more than just repairs, but optimisation of the equipment. The system prioritises faults according to its severity and operational energy cost of avoidance.



**PRESENTER:**

**PROFESSOR THOMAS SCHROEPFER**  
ASSOCIATE HEAD OF PILLAR,  
ARCHITECTURE AND SUSTAINABLE  
DESIGN, SINGAPORE UNIVERSITY  
OF TECHNOLOGY AND DESIGN.

Professor Thomas Schroepfer is the principal investigator for *The Future of Cities: Future Urban Typologies*, a study on innovative urban design and architecture forms and prototypes for future living in cities.

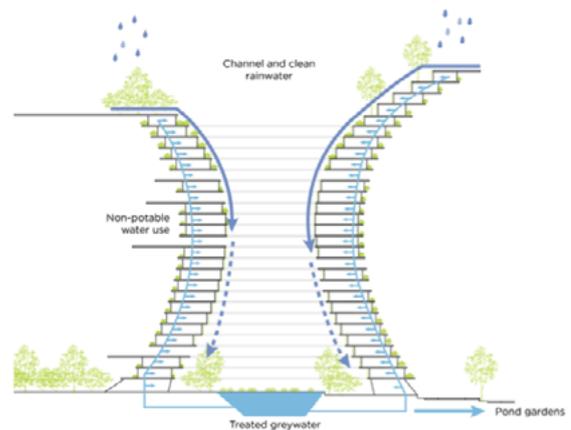
## The Future of Cities: Future Urban Typologies



Proposed urban scenario with innovative building typologies for the Keppel-Labrador site.



Parcel Area:	79,358 m <sup>2</sup>
Building Footprint:	13,514 m <sup>2</sup>
Site Coverage:	17.03 %
GFA:	175,836 m <sup>2</sup>
GPR:	2.22



The Sky Hive building typology maximises views from all angles of the site, while interspersed empty spaces within the facade allow for cross-ventilation for the residential units. Generous green spaces channel and filter rainwater into the river plains and to the Bukit Chermin

drainage outlet. Water harnessed from rain harvesting are channelled through four layers of phytoremediation; this is supported by the building's organic form, which enable optimal sun exposure for plants to carry out phytoremediation.



# COLLABORATING WITH COMMUNITIES

Successful homes and shopping streets are experienced through human connections. These connections take time to build through different levels of collaboration with the community. For instance, HDB's *Greenprint* initiative adopted a holistic community engagement strategy to match the resident's level of commitment. For engaged residents, new communities are formed to take ownership of solutions such as in-door greenery, for less engaged residents, they are able to provide their feedback and concerns on these changes. The collective impact is the creation of a layer of human connections scaffolding HDB's *Greenprint* initiative. Other projects such as CLC's *Reimagining Orchard Road* builds upon pre-existing social networks. The team engaged business and consumer communities to distil their routine use of space. This prevents the over-representation of any groups' interest, while finding common ground where recommendations would be well-received.

PROJECT NAME: REIMAGINING ORCHARD ROAD  
PRESENTED BY: MICHAEL KOH, FELLOW AT  
THE CENTRE FOR LIVEABLE CITIES  
SUPPORTED BY: CENTRE FOR LIVEABLE CITIES



## HOW DO WE RE-INVENT AN ICONIC SHOPPING STREET?

# HOW DO WE RE-INVENT AN ICONIC SHOPPING STREET?

## *The Big Idea:*

### ***Pedestrianize Orchard Road***

*Applying principles from its research into car-lite pedestrian-friendly strategies, urban design interventions and successful shopping streets worldwide, the Centre for Liveable Cities (CLC) suggests ways to reimagine Orchard Road.*

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Most people go to shopping streets for reasons other than shopping: they are attracted by activities on such streets that offer rich experiences. This is one of the many findings revealed by the Centre for Liveable Cities, after studying successful shopping streets such as Omotesando in Tokyo and Champs Elysees in Paris. CLC applied their findings to Singapore's Orchard Road and propose the pedestrianisation of the street, so as to make Orchard Road less of a one-way shopping street experience.

CLC's proposes that four areas in the re-imagined Orchard Road be dedicated to 'family fun', 'high street brands', 'youth and night life', and 'civil and cultural' activities. This builds on existing characteristics in the district. The Somerset area, for instance, is already largely visited by young people, while Tanglin already hosts family-oriented activities in its larger complexes such as the Forum Galleria Shopping Centre. Building on local strengths maintains the authenticity of the street, rather than trying to impose an artificial theme. CLC's proposal includes the imaginative adaptive reuse of black and white

bungalows in the Tanglin area as restaurants and cafes. A market square, similar to Union Square in New York City, could also be included in Tanglin. The current residential areas could also be transformed into a producer's zone, with vegetable gardens.

The CLC team also considered implications for traffic. To support the pedestrianisation of Orchard Road, CLC proposes to turn Orchard Boulevard into a two-way traffic system. In addition, a tram could traverse the length of Orchard road to serve public visitors to the area.

The pedestrianisation of Orchard Road will likely yield many benefits, such as reducing air and noise pollution, increasing retail, and infusing greenery into the landscape. Delightfully, butterflies are already returning to Orchard Road and pedestrianisation would further enable a biophilic corridor to develop, encouraging such attractive wildlife to linger along a proposed green link from Singapore Botanic Gardens into Orchard Road.



“

Where do cars go [after pedestrianization]? I think I asked the same question of George street and Oxford street. And they said, cars will find their own way, buses will be re-routed. It can be done. I think it is the vision and imagination and that form of thinking that is going to reinvent these cities.

”

MICHAEL KOH  
FELLOW

CENTRE FOR LIVEABLE CITIES, MINISTRY OF NATIONAL DEVELOPMENT



**PRESENTER:**

**POON KING WANG**

LEE KUAN YEW CENTRE FOR  
INNOVATIVE CITIES (LKYCIC),  
DIRECTOR

Poon King Wang leads the project team in the *Future of Cities – Living with Technology* study that culminated in the report *Living Digital 2040: Future of Work, Education, and Healthcare*. The project is a 2-year study funded by Singapore’s Ministry of National Development (MND) and the National Research Foundation (NRF).

His team used a multi-disciplinary approach to examine major technology developments, their opportunities and challenges to city-scale systems in the interaction between the physical and digital world, and how solutions and services in these systems can be people-centric.

## Living Digital 2040: Future of Work, Education and Healthcare



The scenarios of the Future of Work was distilled from the LKYCIC team's extensive interviews and trans-disciplinary research—spanning design, sociology, human-computer interaction, human-robotics interaction, Big Data, Internet of Things, IT and organisations, fashion design, industrial design, telecommunications, banking,

consumer products, and public policy. The image highlights their highly visual approach for their report to make it accessible to the public. The axes capture the key dimensions of each domain and the characters represent some of the lived experiences in that possible future.

**PRESENTER:**  
**DR RINUS VIS**  
DIRECTOR, NUS DELTARES

Dr Rinus Vis leads the NUS-Deltares team in establishing SeCURE: Singapore Centre on Urban Resilience. The centre's objective is to strengthen urban resilience of South-east Asian coastal cities.

Dr Rinus Vis presented on a recent study by NUS (IWP) and Deltares that distilled 5 principles for resilience, such as, adopting a systems approach and to build and prepare infrastructure according to the remain functioning principle.



PROJECT NAME: HDB GREENPRINT  
PRESENTED BY: LEONG KIAN LI, SENIOR ENGINEER, BUILDING & RESEARCH INSTITUTE, HOUSING & DEVELOPMENT BOARD  
SUPPORTED BY: HOUSING DEVELOPMENT BOARD (BUILDING & RESEARCH INSTITUTE)



# HOW DO WE RETROFIT BELOVED HOMES?

# HOW DO WE RETROFIT BELOVED HOMES?

## *The Big Idea:*

***Combine new sustainable solutions with community engagement and education***

*The HDB Greenprint initiative retrofits greener HDB town development to create more sustainable homes.*

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Retrofitting existing homes with more sustainable solutions is often met with resistance. Home owners are often unable or unwilling to appreciate the benefits of these solutions. Recognising these challenges, the Housing Development Board (HDB) approaches retrofitting by introducing sustainable and liveable solutions with a strong community engagement strategy.

HDB piloted the Greenprint project at Yuhua, Jurong East, Teck Ghee and Ang Mo Kio from 2012 to 2018, involving 78 blocks of flats and approximately 10,000 homes. Some of the initiatives introduced included: car-lite solutions with enhanced storage facilities and cycling/walking paths, new greenery, new energy systems, water conservation and waste management solutions. Preliminary results have been encouraging. For instance, greenery introduced on rooftops and building facades helped reduce the urban

heat island effect. Rooftop greenery reduced ambient temperatures by 1.6 degrees Celsius; thermographic scans showed that the introduction of vertical greenery reduced surface temperatures by an impressive 7 degrees Celsius.

These solutions were introduced together with a three-pronged community engagement strategy. Sustainable eco-lifestyles were brought to the attention of residents through roadshows, exhibits, dialogue sessions and learning journeys. Next, residents were encouraged to adopt some of these solutions themselves; more than 40 residents took up hobby farming. Finally, HDB helped to build communities through initiatives to create strong social institutions behind the sustainable solutions. These efforts reached some 3,000 residents; feedback indicates they were well received.

**PRESENTER:**

**LEONG KIAN LI**

SENIOR ENGINEER, BUILDING &  
RESEARCH INSTITUTE, HOUSING  
& DEVELOPMENT BOARD

Leong Kian Li presented HDB's Greenprint initiative, which sought to retrofit existing buildings with sustainable and liveable solutions, while engaging the community to take ownership of these urban solutions.



## HDB Greenprint



In its pilot at Yuhua and Jurong East, HDB's *Greenprint* initiative successfully led the community to embrace sustainable and liveable solutions such as the Community Parklets, which is maintained by a group of volunteers living in Yuhua.

# CONCLUSION

Government agencies, research institutions and those from the private sector have spent many years accumulating knowledge in our own domains. Although the lens of our expertise enable us to perceive deep issues, this same lens could blind us to the rich opportunities that collaboration could afford us.

The effects of globalisation have also increased the complexity of urban issues and systems. For instance, contemporary issues of sustainability require a broad spectrum of knowledge to break unsustainable processes and institutions. Failing to collaborate meaningfully for these issues would mean that we run the risk of becoming collectively less resilient.

Fortunately, as *Cities Roundtable 2017* have shown, we are starting from a strong place. There is a strong trend in using technology and digital tools, pilots and scaled-up testbeds to forge collaborations across different knowledge domains. We are also finding new ways to tap on the value of collaborating with communities.

Moving forward, *Cities Roundtable* aim to continue encouraging and inspire collaborations between key stakeholders in Singapore.

# PRESENTATIONS AND SUPPORTING ORGANISATIONS AT CITIES ROUNDTABLE 2017

PRESENTATION TITLE	PRESENTER	ORGANISATION
Ecosystem Services in Urban Landscapes	Professor Peter Edwards, Director, Principal Investigator at Singapore-ETH Centre, Future Cities Laboratory	Singapore-ETH Centre, Future Cities Laboratory
Effects of Horticultural therapy on Asian Elderly Mental health	Angelia Sia, Deputy Director at National Parks Board (NParks)	Centre for Urban Greenery and Ecology (CUGE), National Parks Board (NParks)
Explorations into 3D Geospatial Data and Applications in Urban Greening	Dr. Ervine Lin, Researcher at CUGE, NParks	
GEMMA – GIS-Enabled Mapping, Modelling and Analysis	Huang Zhongwen, Senior Planner at Urban Redevelopment Authority (URA)	Urban Redevelopment Authority (URA)
3D National Mapping	Dr. Victor Khoo, Deputy Director at Singapore Land Authority (SLA)	Singapore Land Authority (SLA)
Interactive Urban Modelling – A Prototype on Singapore	Zhou Yimin, Senior Assistant Director at Centre for Liveable Cities (CLC), Ministry of National Development (MND)	Centre for Liveable Cities (CLC), Ministry of National Development (MND)
Living Digital 2040: Future of Work, Education and Healthcare	Poon King Wang, Director at Lee Kuan Yew Centre for Innovative Cities (CIC), Singapore University of Technology and Design (SUTD)	Lee Kuan Yew Centre for Innovative Cities (CIC), Singapore University of Technology and Design (SUTD)
Future Urban Typologies: Innovative Urban Design and Architecture Forms	Professor Thomas Schroepfer, Associate head of Pillar, Architecture and Sustainable Design at SUTD	SUTD
The Future of Us Pavilion	Thomas Wortmann, PhD Candidate at Architecture and Sustainable Design, SUTD	SUTD
Integrated Smart Estate and Building Operations System	Siew Yim Cheng, Chief Information Officer at JTC Corporation	JTC Corporation
Resilience in Practice	Dr. Rinus Vis, Director, NUSDeltares	NUSDeltares
HDB Greenprint	Leong Kian Li, Senior Engineer, Building Research Institute (BRI) at Housing and Development Board (HDB)	Housing and Development Board (HDB)

Cities Roundtable 2017 is organized by the  
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## About the Centre for Liveable Cities

Set up in 2008 by the Ministry of National Development and the Ministry of the Environment and Water Resources, the Centre for Liveable Cities (CLC) has as its mission “to distil, create and share knowledge on liveable and sustainable cities”. CLC’s work spans three main areas— Research, Capability Development and Knowledge Platforms. Through these activities, CLC hopes to provide urban leaders and practitioners with the knowledge and support needed to make our cities better.

[www.clc.gov.sg](http://www.clc.gov.sg)

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