

Transformative Research on Future Cities - Sharjah Learning Event

Educational Material

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Transformative Research on Future Cities - Sharjah Learning Event

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Singapore, October 15-19 2018

Transformative Research on Future Cities – Sharjah Learning Event

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Knowledge Note on Learning as Transformative Research on Future Cities

The German Advisory Council on Global Change (WBGU) in its flagship report *World in Transition: A Social Contract for Sustainability* (2011) offers the clearest statement on transformative research. The report calls transformative research one of the 'instruments of interdisciplinary research' that is required to steward, curate and actively guide the 'great transformation' to low-carbon future (WBGU 2011, 351). For the WBGU, transformative research is characterised by a capacity to span a 'spectrum that reaches from purely discipline-based to system-based research', and cross-fertilise between the two, while engaging 'with society, the economy, and politics', considering 'global usability', 'intercultural transferability' and the potential 'rebound effects and 'path dependencies'. It is a form of research that requires a systems perspective, 'inter- and cross-disciplinary method, including stakeholder participation', and 'a higher level and innovative forms of communication to support interaction and participation in social dialogue (WBGU 2011, 351).

Transformative research is aligned to, but differs from applied, transformation and translational research. The focus on actively advancing the transformation involves a larger commitment than understanding it (which WBGU call 'transformation research'). Similarly, applied and translational modes of research, which are often highly sensitive to local contexts and agencies of the research, often miss the systemic aspect of the research.

Future Cities Laboratory (FCL) has actively sought to develop design as a medium and practice for conducting transformative research. Many of the research project teams include designers, be they architects or urban designers. The scenarios, and the High-Density, Mixed-Use (Water Front Tanjong Pagar) scenario in particular, as the most developed, have also become important sites for the development of our own contribution to transformative research by design. We believe that this approach helps balance applied and theoretical research by serving as an interface medium between the two. The emphasis on drawing, diagramming, visualisation in design, as well as the collaborative possibilities of the studio space, have been important in translating between theory and application. Articulating the idea of a transformative research by design, is particularly important for a large and multi-disciplinary group so that the synergistic possibilities of this mode of research are made as transparent and accessible as possible.

FCL at the Singapore-ETH Centre (SEC) offers Learning Events developed by the Education Research Programme under its Engagement Platform. The Education Research Programme defines education research topics arising from research projects and scenarios at FCL. It develops teaching methods to deliver communicable, teachable and applicable outcomes as key contribution to FCL's commitment to transformative research. Over the past years the programme developed courses for Singaporean universities, the Urban Redevelopment Authority and the World Bank involving theoretical knowledge impairment, technical skill development and sustainable urban design (Cairns, von Richthofen, and Andrew 2018; von Richthofen 2018).

The Learning Event 'Transformative Research on Future Cities – Sharjah' offers specialist urban design knowledge, skills and understanding in the topics outlined below as a means to integrate the diverse disciplinary skills that participants have, such as architectural design, landscape design, and social and environmental analysis. The programme draws from the excellent research body of FCL and its affiliated partners in Singapore to deliver state of the art input lectures. The inter-disciplinary teaching team has a track-record of teaching professionals and is attune to cultural sensitivities. The learning event will be hosted at FCL from October 15-19th 2018.

Prof Dr Stephen Cairn, Director
Aurel von Richthofen, Education Research Leader

Future Cities Laboratory
Singapore, October 2018

References:

- Cairns, Stephen, Aurel von Richthofen, and Stokols Andrew. 2018. "Disruptive Technologies for Development." Report. Singapore: Singapore ETH Centre & The World Bank Singapore Hub. <https://doi.org/10.3929/ethz-b-000273998>.
- Richthofen, Aurel von, ed. 2018. *Urban Elements - Advanced Studies in Urban Design*. Singapore: Singapore ETH Centre. <https://doi.org/10.3929/ethz-b-000270354>.
- Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WGBU, Germany), ed. 2011. *World in Transition: A Social Contract for Sustainability*. Berlin: German Advisory Council on Global Change.

Programme outline

The Learning Event addresses Smart City development strategies by examining projects and the concept of Smart Nation in Singapore and China. Transportation and Energy are seen as integral parts to a smart / sustainable development. It examines the case-studies of Tianjin Eco-City in China and Tanjong Pagar in Singapore to draw on planning structure and urban development. The Learning Event closes with lectures on dense and green architecture.

Learning structure

The two day Learning Event will adopt an interactive seminar style with input lectures and workshops delivered by FCL researchers and the core teaching team in the morning from 9:00-12:00 and early afternoon 13:00-15:00 on day 1 and 2. Each lecture section of 90 minutes is divided into three parts: A presentation by the lecturer on the topic, a questions and answers discussion based on a text distributed ahead and a collective SWOT analysis for the topic presented in the Sharjah context. This will be followed by site visits in the later afternoon from 15:00-17:00 and a debrief / recap of relevant learning items. Days 3,4&5 are dedicated to visits to Singaporean Authorities including Housing & Development Board (HDB), JTC CleanTech Park, Centre for Liveable Cities (CLC), Urban Redevelopment Authority (URA), Public Utilities Board (PUB) and Lopelab.

Target Audience

The target audience are post-professional engineers with 2-5 years of working experience of the Directorate of Town Planning and Survey (DTPS) Sharjah, UAE, accompanied by high ranking individuals in the organization, such as the Director General of Town Planning and press. The learning event assumes participants have academic background in architecture, landscape architecture, urban design, planning or related field. The group size for effective learning shall not exceed 20 individuals. Alternatively, the learning event can be repeated for additional groups or tailored to specific needs.

Day 1, Monday October 15th 2018, FCL:

8:30 – 9:00 Reception and Welcome to FCL

Dr Stephen Cairns Future Cities Laboratory / Aurel von Richthofen Future Cities Laboratory

9:00 – 10:15 From Data to Design

- Responsive Cities vs Smart Cities
- Decoding Urban Design and Planning questions with Data
- Crowdsourced data collection methods
- Citizen Design Science as a key element in Smart Nation building
- Impacts and perspectives on Urban Governance

Speakers: Dr Bige Tuncer Singapore University of Technology and Design, Fabien Clavier Future Cities Laboratory

10:15 – 10:30 Coffee Break

10:30 – 12:00 Eco-City Development

- Project introduction
- KPI Framework and Integrated Master Planning
- Key Eco-Features

Speaker: Whoo Kiat Heng, Ministry of National Development, Eco-City Project Office

12:00 – 13:00 Lunch Break

13:00 – 14:30 Engaging Mobility

Singapore's Approach to Developing a Sustainable 'Integrated Transport System'

- Current achievements.
- Policy framework.
- Holistic & integrated.
- Notable initiatives.
- Successful projects

Speakers: Dr Michael van Eggermond & Dr Pieter Fourie Future Cities Laboratory

14:30 – 15:00 Travel to site by bus

15:00 – 17:00 Site Visit: Marina Bay, Central Business District, Barrage

Point of Contact: Geoffrey Stephens, PUB

3pm	Arrival	Welcome by George Madhavan, Director Centralised Services, PUB
3.05pm	Briefing about Singapore Water Story	Briefing by Director
3.40pm	Tour of Sustainable Singapore Gallery	Tour conducted by Docent

Day 2, Tuesday October 16th 2018, FCL:

9:00 – 10:15 Integrated Design of Urban Energy Systems

- Test-bedding Projects (to improve performance of energy systems & develop innovative ways of integrated system to the cities' environment).

Speaker: Prof Dr Arno Schlüter, ETH Zürich

10:15 – 10:30 Coffee Break

10:30 – 12:00 High-Density Mixed-Use

A framework towards the design of dense and adaptable urban space in the context of programmatic indeterminacy.

- Waterfront Tanjong Pagar, developed by the Future Cities Laboratory, is the first interdisciplinary urban design proposal that brings together all of FCL's research and design expertise.
- The project combines strategic master planning, innovative mobility concepts design with autonomous vehicles in mind, dense and diverse urban settings, eco-system services and energy efficiency.
- The integration and design coordination of this smart and responsive city was a major challenge and is a roadmap for future Singaporean urban design developments.

Speaker: Dietmar Leyk, Future Cities Laboratory

12:00 – 13:00 Lunch Break

13:00 – 14:30 Dense & Green

- Cases of Dense & Green building typologies in Singapore
- Economic, social, design and environmental benefits of greenery in buildings
- Hedonic pricing analysis on greenery influence on real estate value

Speaker: Dr Michelle Yingying Jiang, Future Cities Laboratory

14:30 – 15:00 Travel to site by bus

15:00 – 17:00 Site Visit: Bishan Park, Punggol Waterway

3pm	Arrival	Welcome by Dr Michelle Yingying Jiang, Future Cities Laboratory
3.05pm	Briefing about Singapore Punggol Project	
3.40pm	Tour of Bishan Park, Punggol Waterway	Tour conducted by Docent

Recap of learning event and workshop evaluation

Day 3 Wednesday, 17 October 2018		
9.30 AM	<p>Meeting with Housing & Development Board (HDB)</p> <p>Venue: HDB Hub, 480 Lorong 6 Toa Payoh, Singapore 310480</p>	<p>Daphne Pang Senior Corporate Communications Manager DID: +65 6490 1272</p>
4.00 PM	<p>Visit to JTC CleanTech Park</p> <p>Venue: JTC CleanTech One, 1 CleanTech Loop, Singapore 637141</p>	<p>Rachel Pan Manager, Communications Division DID: +65 6883 3623 HP: +65 9173 5044</p>
Day 4 Thursday, 18 October 2018		
10.00 AM – 11.00 AM	<p>Visit to Centre for Liveable Cities (CLC)</p>	
2.30 PM – 4.00 PM	<p>Meeting with Urban Redevelopment Authority (URA) and Tour of URA Digital Planning Lab Sandbox</p> <p>Venue: The URA Centre, 45 Maxwell Road, Singapore 069118</p>	<p>Daveen Koh Executive Planner, URA Academy DID: +65 6671 1099</p>
Day 5 Friday, 19 October 2018		
10.00 AM – 11.00 AM	<p>Meeting with Lopelab Pte Ltd</p> <p>Venue: 1 Keong Saik Road, The Working Capitol, Singapore 089109</p>	<p>Jerald Lim Project Manager HP: +65 9739 6659</p>

Learning Event Details - Day 1&2



Welcome to FCL

Prof Dr Stephen Cairns, Director, Future Cities Laboratory

completed an undergraduate degree in anthropology and classical studies at the University of Otago. He trained in architecture at the University of Auckland, and practiced as an architect in New Zealand, Australia and the Pacific, designing the award-winning Headquarters for the Secretariat of the Pacific Community in Noumea. He subsequently undertook doctoral studies at the University of Melbourne, where he wrote a thesis on the colonial architecture in Java, with an emphasis on aesthetics and the politics of representation. On completion of his PhD, he was appointed to a Lectureship at the University of Melbourne. He took up a Senior Lectureship at the University of Edinburgh, and was appointed Professor of Architecture and Urbanism there in 2009. He served as Head of Department of Architecture, and Director of the Edinburgh School of Architecture and Landscape Architecture. He is currently based in Singapore where he is Programme Director of the Future Cities Laboratory.

Aurel von Richthofen, Senior Researcher & Learning Event Coordinator, Future Cities Laboratory

is a Senior Researcher, Education Research and Engagement Platform Leader at FCL. Aurel joined FCL in the 2014 as project coordinator of the Alternative Construction Materials group and has since lead a variety of synergetic research projects and exchange activities for FCL. From 2010 - 2014 he was Assistant Professor at the German University of Technology in Oman affiliated to RWTH Aachen in Germany. He was co-investigator on the research project "Urban Oman – Towards Sustainable Patterns of Urbanisation" funded by the National Research Foundation, Oman. The Urban Oman project resulted in a collection of academic publications, exhibitions, a book and his dissertation. From 2007 - 2010, Aurel taught architectural design, parametric design and digital fabrication at TU Berlin in Germany and at the Ohio State University in Columbus, Ohio, U.S.A. He is a graduate of ETH Zürich and Princeton University and a licenced architect in Berlin, Germany.

Day 1 9:00 – 10:15 From Data to Design



Key Learning Points

- Responsive Cities vs Smart Cities
- Decoding Urban Design and Planning questions with Data
- Crowdsourced data collection methods
- Citizen Design Science as a key element in Smart Nation building
- Impacts and perspectives on Urban Governance

New creative ideas for Singapore's Smart Nation

With the rising complexity of modern cities, traditional urban planning, urban design and urban management methods reach their limits. Life in a city has become increasingly dynamic, whereas urban planning often relies on static and sectorial approaches, involving a very limited number of citizens and stakeholders in relevant decisions.

At the same time, Big Data is becoming an exponentially growing source for evidence-based high-quality decisions by analysing existing or past situations. By using various types of geo-referenced data, such as socio-economic data of people, mobility traces, urban sensors' data, social media or citizen direct feedbacks, it is now possible to detect correlations between spatial configurations and behavioural phenomena in more detail.

While information derived from Big Data make urban planners and designers more informed and aware, it also strengthens the role of Design as an activity that sets goals beyond past evidence and fosters creative ideas for the future development of our cities.

When Singapore's PM Lee Hsien Loong shared his vision of a Smart Nation in Nov 2014, it was clear that the combination of Big Data and Design Thinking will be key in achieving the ambitious plan of transforming Singapore through innovation. Today, every major urban planning decisions in Singapore start with Data and Design: understanding the issues, defining the problem, coming up with creative ideas and solutions, prototyping an idea, testing out the innovations and constantly reviewing the thinking and solutions.

Combining Data and Design for urban planning challenges also means engaging current and prospective residents from the very beginning in the planning and management of their habitat. This is made possible by taking advantage of new and abundant forms of data, new ways of exploiting data

sets, new sensing technologies, and new possibilities for interaction among people, communities and their physical environments.

Prof Bige Tunçer and Fabien Clavier will present some of the ongoing research projects led at ETH Zurich's Future Cities Laboratory in Singapore. They will elaborate on the use of technological advances to help citizens, communities and authorities understand the functioning of cities and the consequences of different urban planning options. By systematically exploring the practical potential of Big Data, their work aims at offering design solutions for sustainable future cities while providing answers regarding the impact on society as a whole.

SWOT Analysis and Translation to the Sharjah Context

Strengths	Weaknesses
Technology development / adoption encouraged by the government Small Nation = agile Tools and platforms for fast, fair and transparent decision making Support 'good' urban design	Multi-scale – sprawl, car-based mobility, functional urban planning Mentality, age of citizens Question representation of data sourced 'Digital Divide' Big Data Variety = heterogeneous and unstructured data Bias in bid data sources and interpretation, despite AI etc.
Opportunities	Threats
Privacy – Planners Happy Moment Citizen satisfaction Crowdsourced data collection Citizen Centric Urban Planning Access to wifi, pay for data plans, hand out smart phones and devices Collaborate with industry (mobile phone and server) Compare to data in Dubai and Abu Dhabi	Privacy – Citizens How to save and manage data safely and future-ready? Commodification (sell-out) of data by industry

Prof Dr Bige Tunçer, Singapore University of Technology and Design

is an associate professor and the associate head of pillar at the Architecture and Sustainable Design Pillar of Singapore University of Technology and Design (SUTD). At SUTD, she founded the Informed Design Lab. The lab's research focuses on data collection, information and knowledge modeling and visualization, for informed architectural and urban design.

She received her PhD in Architecture (design informatics) from Delft University of Technology (TU Delft), her MSc (computational design) from Carnegie Mellon University, and her BArch from Middle East Technical University. She was an assistant professor at TU Delft, a visiting professor at the Chair of Information Architecture at ETH Zurich, a visiting scholar at MIT, and a visiting professor at Computer Engineering Department of University of Pavia, Italy. Her research interests include evidence based design, big data informed urban design, and design thinking. She leads and participates in various large multi-disciplinary research projects in evidence informed design, IoT, and big data. She has taught many design computation and studio courses to undergraduate and graduate students. Currently she leads and teaches Capstone, where student groups from various engineering directions and architecture work together on industry defined and funded design projects and develop design prototypes.

Fabien Clavier, Future Cities Laboratory

is an urban planner with experience in master-planning, smart cities and urban data projects. He is currently Project Coordinator for the Big Data-Informed Urban Design and Governance group. Fabien worked for more than four years on the Greater Paris project, which aim is to create 200 km of new metro lines, boost housing construction and kick-start an innovation-based economic growth. He used to develop masterplans for two strategic areas: Orly Airport City and Paris Saclay Innovation Cluster. More recently, he was Project Lead for a French-Singaporean lab dedicated to inclusive smart cities and digital public health. Through different EU projects, he worked on building extensible models and technologies to predict, mitigate, and manage public health problems and promote community health in cities. Fabien has also undertaken urban projects and policy consulting missions in Surabaya (Indonesia), Tokyo, and Barcelona.

Fabien is interested in big data-informed urban governance and how urban stakeholders can benefit from big data-derived methods to increase transparency, accountability, and equal voice in planning. This requires policymakers and planners to define pressing questions and cities to support these with timely information, while understanding the uncertainty of urban data systems.

Recommended reading

Anthony M. Townsend: **Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia**, W. W. Norton Inc., New York, ISBN-978-0-393-082867-6 hardcover; ISBN-978-0-393-34978-8 pbk

Day 1 10:30 – 12:00 Smart City Development



Key Learning Points

- Project introduction
- KPI Framework and Integrated Master Planning
- Key Eco-Features

Sino-Singapore Tianjin Eco-city project

The Sino-Singapore Tianjin Eco-city is a bilateral collaboration project between Singapore and China to develop an economically vibrant, socially harmonious, environmentally friendly and resource-efficient city in Tianjin. The project was conceived in 2007 against the global backdrop of climate change and rapid urbanisation. Singapore and China wanted to develop an eco-city that will serve as a model of sustainable development for China and the world.

1. The Eco-city project was located on a site that used to comprise non-arable saline land and polluted waterbodies. The site was specially chosen to demonstrate that sustainable development could be achieved despite difficult environmental challenges.
2. The entire Eco-city project spans 30 km², including a start-up area of 8 km². Through the joint efforts of Singaporean and Chinese stakeholders, the Eco-city has made significant progress in the areas of environmental rehabilitation, green buildings, renewable energy, water management, and environmental protection. These include rehabilitating its 2.6 km² wastewater pond, conducting research in green development, developing green building standards and constructing green buildings, tapping renewable energy sources (wind, solar and geothermal energies), encouraging residents to lead environmentally-friendly lifestyles, and promoting green transport.
3. The start-up area has been completed, and comprises residential developments; social amenities such as schools and community clubs, public parks, hospital; and industrial parks. The focus in the next phase of its development is the city centre in the central district, which will be the heart of commercial, leisure and recreational activities to enhance the Eco-city's attractiveness to businesses and talent to support the future growth of the Eco-city.

SWOT Analysis and Translation to the Sharjah Context

Strengths	Weaknesses
people-people 'desert-belts' eco-corridors 'Good' tourism, close to major cities, scenic landscape, close to the sea	healthy living comprehensive infrastructure (more active mobility, pedestrian friendly) plan as integrated system far from the 100% green buildings in the eco-city
Opportunities	Threats
people-environment people-economy sustainable economic development Eco-cells as building blocks for eco-cities – scalability of concept Eco transport: eco-valley, slow movement network, rail network Mix of energy sources passive housing, low carbon, customised green building, low-carbon living lab waste water management (become a future resource)	balance of man-made + environment Managing scarce water (desalination)

Whoo Kiat Heng, Ministry of National Development, Eco-City Project Office

is the Director in the Eco-City Project Office in the Ministry of National Development (MND), which oversees the Sino-Singapore Tianjin Eco-City project in Singapore.

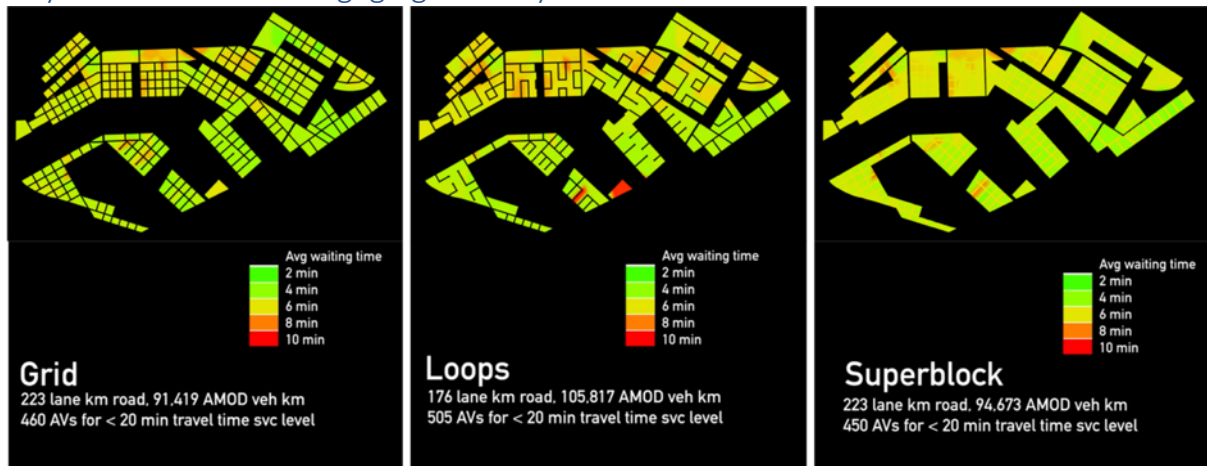
Prior to joining the Eco-City Project Office, he was Director Policy and Licensing in the Council for Estate Agencies, a statutory board under MND, regulating the work of real estate agencies and agents; and Deputy Director Infrastructure in MND overseeing the planning and policies for construction, green buildings, climate change resilience, and building maintenance and management.

He has also held other positions overseeing urban planning policies on housing, industrial land use, and heritage conservation; and visual arts, cultural centre and library policies.

Recommended reading

Lynch, Kevin. 1960. "The Image of the Environment." In *The Image of the City*, 1–13. Publication of the Joint Center for Urban Studies. Cambridge, Mass.: MIT PRESS.

Day 1 13:00 – 14:30 Engaging Mobility



Key Learning Points

- Current achievements.
- Policy framework.
- Holistic & integrated.
- Notable initiatives.
- Successful projects

Future Mobility in Singapore

Singapore is a hotbed for the development and testing of new mobility technologies. Policy design aims to apply these technologies in such a way that Singapore becomes car-lite; if the country is to attain its population growth and development goals, the mobility needs of a future population needs to be met by alternatives to the private car.

In this session, we will examine the policy avenues open to the country in attaining this goal, and the various challenges that exist. How does one provide a last-mile solution to the MRT backbone that will produce travel times that are competitive with the private car? What are the opportunities and limitations of deploying shared autonomous vehicles at scale, and how should they be operated? How does one design neighbourhoods to maximise mobility benefits from shared AVs, while at the same time promoting cycling and walking for health benefits, and human-oriented place making? Are aerial taxis a realistic means of transport in the Singapore context, and what would it communicate about the country's transport system?

Selected work from Engaging Mobility, commissioned by the Singapore government, is shown in different case studies. We demonstrate new workflows that embed simulation in the urban design process, allowing the co-evolution of mobility patterns and the built environment. We show how an existing three-dimensional pedestrian network facilitates human flows that are far in excess of what can be achieved by mechanical means, be it self-driving or not. And we use virtual reality to test how Singaporeans may be enticed to the joy of personal mobility achieved by cycling, even in the harsh climate of the tropics.

In engagement with the audience, we attempt to identify which of these initiatives are of relevance in the Sharjah mobility context. We discuss the implications of the greatest contrasts with Singapore and the agenda for further research.

SWOT Analysis and Translation to the Sharjah Context

Strengths	Weaknesses
Walkable city centre, corniche and neighborhoods	Heavy transit is not charged Lack of integrated transport planning between Emirates Incentives to own a car
Opportunities	Threats
Walking Cycling: connected cycle tracks Anchor alternative mobility in urban planning Link to Dubai Metro Taxi-drivers are not replacing national jobs	Cars threaten engaging mobility Cheap fuel prices undermine public/alternative transportation efforts Don't add additional lanes for more modes of transport!

Dr Pieter Fourrie, Future Cities Laboratory

is the project leader of the Engaging Mobility group at FCL. Pieter has more than 10 years' experience in agent-based transport simulation, and has been an active developer of the open source MATSim project since 2008. He wants to bring these tools into practice, and see simulation used in neighbourhood sketch-planning. Pieter obtained his PhD from ETH Zurich while at FCL and received the ETH Medal for his PhD thesis 'Data-driven Transit Simulation'.

Dr Michael van Eggermond, Future Cities Laboratory

is a senior researcher and project coordinator of the Engaging Mobility group at FCL. Michael's research focuses on pedestrian comfort and cycling in Singapore; his interest lies in the measurement of accessibility, diversity and network measures, and their relationship to travel behavior. Current projects include 'Measuring pedestrian comfort in high-density areas in Singapore' and 'Bike to the Future'. Michael obtained his PhD from ETH Zurich while at FCL for his PhD thesis 'Diversity, accessibility and its impact on vehicle ownership and residential location choices' and holds a MSc from TU Delft. Currently, he is investigating residential location choice in Singapore as well as factors influencing cyclability in the tropics.

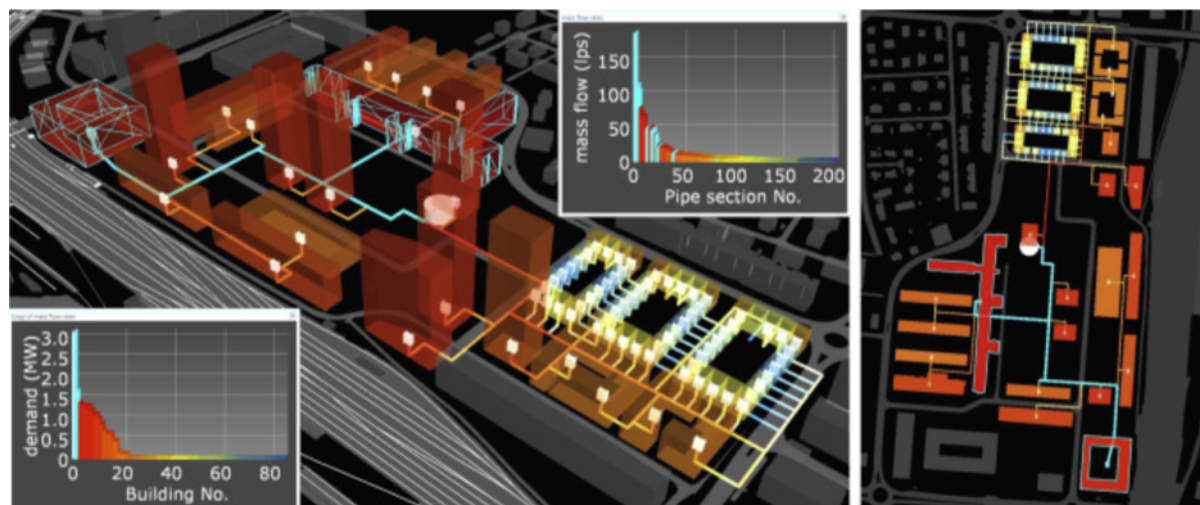
Recommended reading

Singapore Urban Transport: The Warts-and-All Story

[Paul Barter](#) on [August 06, 2018](#)

Listen to the podcast here: <https://www.reinventingtransport.org/2018/08/singapore-story.html>

Day 2 9:00 – 10:15 Integrated Design of Urban Energy Systems



Key Learning Points

- Test-bedding Projects (to improve performance of energy systems & develop innovative ways of integrated system to the cities' environment).

City Energy Analysis and Urban Design

The lecture departs at describing the relevance of cities for human development, the impact of the built environment on climate change and vice versa, the impact of climate change on the development and well-being of cities and their dwellers. The stress on cities is manifested in environmental impacts such as the urban heat island effect, noise and increasing energy consumption. Reflecting on the importance of availability and supply of energy for urban development, societal concepts for future low-carbon cities are introduced. Concepts include the Swiss '2000 W society' and the UN Sustainable development goals, including relevant targets and baselines. Challenges of re-introducing renewable energy sources into the city and the subsequent design of future urban energy systems will be introduced. The interactions between building use types, density and the available surface area will be demonstrated based on research results.

As an approach for integrated design, prerequisites for a holistic approach such as data, engineering and data-driven models and integrated design processes will be described and discussed. Their implementation into a recent integrated design and optimisation environment, the 'City Energy Analyst' will be demonstrated. The availability of such a toolset allows for consideration of interconnections between architectural/urban design and energy systems, stressing the importance of the integration of urban energy systems into design decision making. Using case studies from moderate and tropical climates, latest research results will be used to demonstrate the efficacy of approach and toolset.

SWOT Analysis and Translation to the Sharjah Context

Strengths	Weaknesses
Solar potential 2-3 times higher than in Europe: Use Photovoltaics (solar) Strong government can create 'vision' for sustainable energy use	Active cooling systems required in the summer months (AC) Urban sprawl and residential villas cannot be cooled efficiently Low awareness amongst residents to save energy Low economic incentive to switch to renewables Urban renewable energy resources
Opportunities	Threats
High urbanization rate in UAE Urban concentration in CBD and downtown can result in efficient energy measures Benefits of integrated urban energy systems <ul style="list-style-type: none"> - Target low to zero carbon emission - Synergetic use - Joint exploitation, logistic hoarding - Independence and network security - Motivate social capital Retrofitting of building District scale multi-energy Integrated Design of Urban Districts	Fossil fuels are abundant and cheap; but they are finite Urban Heat Island Effect

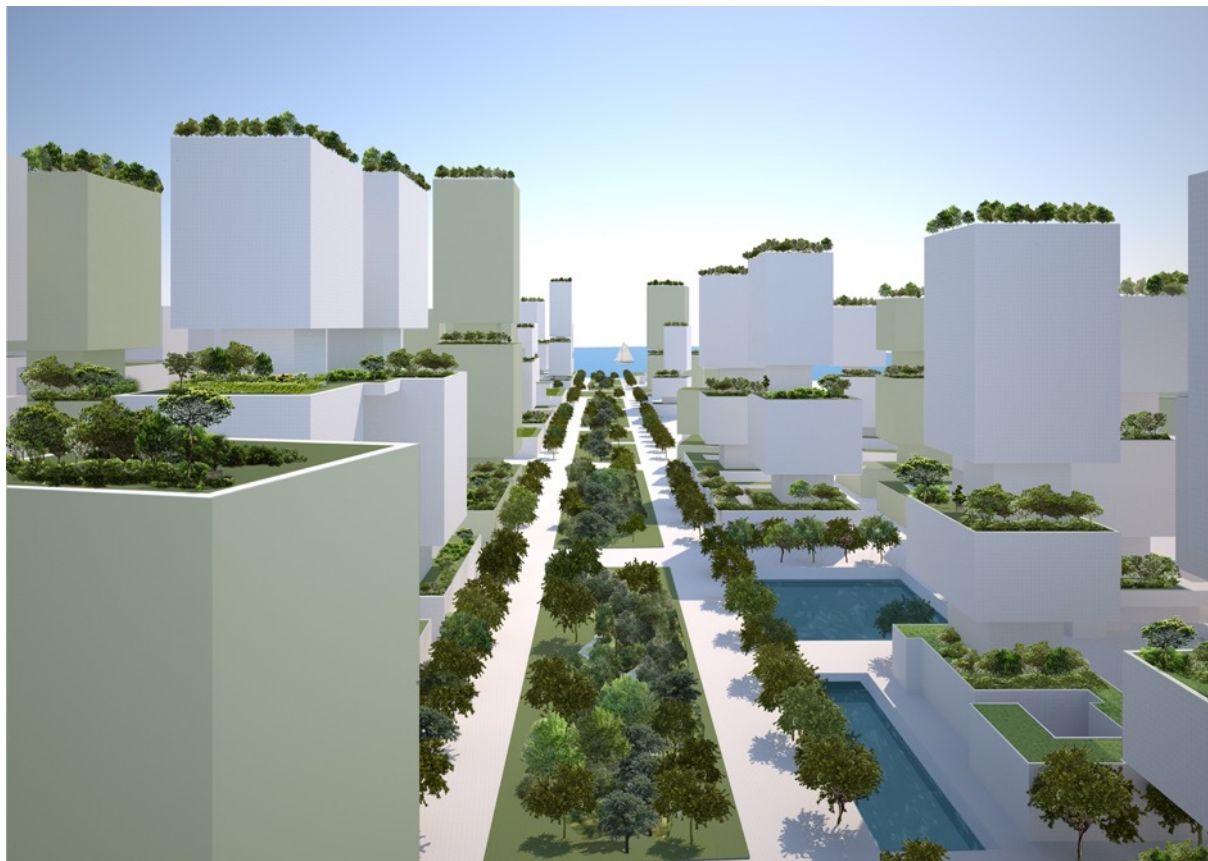
Prof Dr Arno Schlüter, ETH Zürich

Arno Schlueter holds a degree in Architecture from the Technical University of Karlsruhe, a post-graduate degree in CAAD and a PhD in building systems from ETH Zurich. In 2010, he was appointed Assistant Professor and in 2014, Professor of Architecture and Building Systems at the Institute of Technology in Architecture (ITA), ETH Zurich. Since 2013, he is also a Principal Investigator at the Singapore-ETH Future Cities Lab (FCL). In his research, he and his interdisciplinary team focus on energy- and environmental technology and systems and their synergetic integration into buildings and cities using computational approaches for modelling, analysis, and control. He currently is head of the Institute of Technology in Architecture (ITA) of ETH Zürich, Director of Studies of the Master of Integrated Building Systems program and part of the Management Board of the ETH Energy Science Centre.

Recommended reading

Arno Schlueter, Jimeno Fonseca, Gabriel Happle, Shanshan Hsieh, Zhongming Shi, Sreepathi Bhargavakrishna, Krishna Bharathi. 2018. "Connecting the Dots: The Integrated Design of Urban Energy Systems." In *Future Cities Laboratory: Indicia 02*, edited by Stephen Cairns and Devisari Tunas. Singapore ETH Centre: Lars Muller Publishers.

Day 2 10:30 – 12:00 High-Density Mixed-Use



Key Learning Points

- Waterfront Tanjong Pagar, developed by the Future Cities Laboratory, is the first interdisciplinary urban design proposal that brings together all of FCL's research and design expertise.
- The project combines strategic master planning, innovative mobility concepts design with autonomous vehicles in mind, dense and diverse urban settings, eco-system services and energy efficiency.
- The integration and design coordination of this smart and responsive city was a major challenge and is a roadmap for future Singaporean urban design developments.

A framework towards the design of dense and adaptable urban space in the context of programmatic indeterminacy.

In the Waterfront Tanjong Pagar project, expertise in various disciplines comes together with the common goal of a sustainable urban development scenario and a shared research agenda to be tested at the aforementioned waterfront in Singapore. Due to its port activities, the large Tanjong Pagar Container Terminal in the south of the island has always been strategically important to the city-state.

Dominated by industrial and port activities, the area has been cut off from urban life for decades. This has inhibited a direct connection from the Central Business District, the Marina Bay and the Marina South area to the southwestern part of the Greater Southern Waterfront.

The Tanjong Pagar Waterfront project brings together the disciplines of ecology (Ecosystem Services), engineering (Multi-Scale Energy Systems, Cyber Civil Infrastructure, Engaging Mobility), architecture and planning (The Grand Project, Dense and Green Building

Typologies), computer science (Big Data-Informed Urban Design and Governance), psychology (Cognition, Perception and Behaviour) and economy. The project aims to formulate sustainable development guidelines for high-density, mixed-use developments that speak both to scholars and practitioners in these disciplines and to planners, developers and other key stakeholders in such projects globally. Furthermore, the project aims to illustrate these guidelines with a concrete planning scenario for the Waterfront Tanjong Pagar as a practical example of FCL's agenda to work 'through science, by design, in place'. This goal requires us to transgress disciplinary boundaries.

The project, therefore, operates as a science-based collaboration with a design output, bringing together the varied expertise present at FCL.

This would not have been possible in a disciplinarily self-contained manner. It is the aim of the project to build on the knowledge of different disciplines in order to arrive at an understanding and a design proposal that emerges from a cross-fertilisation of the disciplines involved, a form of collaboration also known as a transdisciplinary approach. In doing so, the project's underlying goal is to generate new knowledge grounded in and driven by research which addresses (selected) key challenges for sustainable urban development.

SWOT Analysis and Translation to the Sharjah Context

Strengths	Weaknesses
Highest degree of flexibility and foresight Strong planning tool Scalar technology	Currently, not too many interdisciplinary design workshops Discussion and negotiation process takes a lot of time and resources Capacity in parametric design is a 'steep' learning curve
Opportunities	Threats
High-Density & Mixed-Use Synergies arising from the combination Parametric Design allows the creation of alternatives / options, Scenario Design Collaborative, participatory and interdisciplinary working method 3D printing + Augmented Reality = Immersion	Industry (construction sector) not yet ready – technology adoption challenge Traditional role of the architect / designer is challenged

Dietmar Leyk, Future Cities Laboratory

is the project leader of 'The Waterfront Tanjong Pagar Project', research scenario coordinator for 'High-Density Mixed-Use Cities' at the Future Cities Laboratory and co-principal investigator of the research project 'The Future of Cities: New Urban Typologies' at the Singapore University of Technology and Design (SUTD).

Dietmar Leyk studied architecture at the Architectural Association School of Architecture (AA) in London and at the Technical University in Braunschweig. Dietmar Leyk taught and researched as assistant and interim professor at the ETH Zürich from 1996-2003 on a variety of issues concerned with architectural and urban form.

From 2005 until 2013, he was visiting professor at the Berlage Institute Rotterdam where he researched and taught about Knowledge Spaces –among others he questioned 'How does Architecture Augment Creative Thinking?'

Since 2000 Dietmar Leyk is founding director of Leyk Wollenberg Architects based in Berlin, accomplishing international projects in all scales. They received numerous prizes in international competitions and for their realised work, including the first prize for their project in the international competition for the Lecture Hall and Media Centre for the Technical University in Darmstadt/Germany.

Recommended reading

Richard Sennett, The Open City, Essay

<https://www.richardsennett.com/site/senn/UploadedResources/The%20Open%20City.pdf>

Day 2 13:00 – 14:30 Dense & Green



Key Learning Points

- High-Density
- Greenery
- Sustainability
- Liveability
- Architectural Design
- Urban Planning

Cases of urban simulation & evaluations for deciding between conservation of buildings & green spaces & space demands.

Contemporary architecture and urban design practice are increasingly exploring the integration of green spaces in large-scale buildings, producing new typologies for high-density contexts that include ground garden, landscaped gardens, extensive sky gardens, sky bridges, vertical green walls, roof gardens, and other 'green' components. Combinations of all these, often applied to mixes of residential, civic, and commercial programmes, conjoin at times to produce "vertical cities", in which the building section becomes what the horizontal plane has entailed up to now. Density and sustainability here are not contradictory but somewhat mutually dependent and synergistic. The project overviewed over 600 national and international buildings and selected eight cases (six in Singapore, one in Milan Italy, and one in Sydney Australia) for comprehensive study at design, environmental, social, and economic aspects. The lecture will first introduce the project briefly and the background of dense and green building typologies in Singapore. One of the Singapore cases Punggol Waterway terraces I will be used as an example to show some details of the research project.

The second part of the lecture will be based on the two articles: "Creating Liveable Density through a Synthesis of Planning, Design and Greenery" by Dr Cheong Koon Hean (HDB), and "Punggol Waterway Terraces, Singapore" by Mr Manuel Der Hagopian (G8A). Some joint discussion will be conducted focusing on the topics:

1. The development of HDB town planning from traditional checkerboard to “Eco-town”, and the benefits of such development.
2. Building and greenery design according to the HDB sustainable frameworks.
3. The organisation of multiple layers of greenery in the Punggol Waterway Terraces I project, and its benefits from different respectively.

The lecture will be ended with the conclusion of some building greenery design recommendations and suggestions. Through this lecture, we hope to deliver the information of the current situation of dense and green building typologies in Singapore, and the design of the greenery in high-density cities.

SWOT Analysis and Translation to the Sharjah Context

Strengths	Weaknesses
Eco-system services can provide tangible benefits to society: <ul style="list-style-type: none"> - Urban and architectural design benefits - Environmental benefits - Social / Work benefits - Economic benefits 	Desert climate is not suitable for many forms of vegetation.
Opportunities	Threats
Learn from oasis settlements in the Emirates and the Gulf: Falaj irrigation, date palms and re-use of water. Protect coastal areas. Follow Singapore’s path towards a ‘City in the Garden’ Define a local shade of ‘Green’ that is not water-intensive Explore vertical green buildings Explore urban food production and farming	Greenery needs fresh water that is scarce and energy intensive to produce. Brine can ruin fragile ecosystems. Salt-water infiltration can ruin fresh ground water. Don’t desalinate seawater to irrigate green spaces!

Dr Michelle Yingying Jiang, Future Cities Laboratory

works as project coordinator and postdoc researcher in the project Dense and Green Building Typologies in Future Cities Laboratory, Singapore-ETH Centre. She mainly focusses on the post-occupancy performance of Dense and Green Building Typologies in terms of social benefits.

Michelle JIANG obtained Bachelor and Master Degrees in Architecture Design in China, and PhD degree in The University of Hong Kong. Her research interests include Architectural history, space design, the interrelations between physical space quality and human behaviours, and building flexibility and adaptability. She worked in Module X: Housing in FCL 1.0 as a postdoc researcher for two years. Her research topic was the socio-spatial analysis of elevated public spaces in HDB housing in Singapore. Her works were involved in 2014 The Asia-Pacific Network for Housing Research conference and the project report "Public Space Evolution in High-Density Living in Singapore: Ground and Elevated Public Spaces in Public Housing Precinct". She later participated in the EPFL research group The Smart Living Lab in Blue Factory, Fribourg/Freiburg, Switzerland, where she drafted the programme of building space flexibility and usability. Her research papers were presented in several international conferences and published in some international journals. Besides, Michelle JIANG also worked as the president of CIB-HKU Student Chapter, and she organised several international conferences and seminars.

Recommended reading

Cheong, Koon Hean. 2019. “Creating Liveable Density Through a Synthesis of Planning, Design and Greenery.” In *Dense and Green Building Typologies*, by Thomas Schröpfer and Sacha Menz, 7–12. Singapore: Springer Singapore. https://doi.org/10.1007/978-981-13-0713-3_3.

Event Pictures









Directions to Future Cities Laboratory



DIRECTIONS TO SINGAPORE-ETH CENTRE BY CAR/TAXI

Singapore-ETH Centre | 1 Create Way | #06-01 CREATE Tower | Singapore 138602

via Ayer Rajah Expressway (AYE)

- On AYE towards Tuas: take **Exit 9** and turn left at **Clementi Road** exit or
 - On AYE towards CTE/ECP: take **Exit 9** and turn right at the **Clementi Road** exit
 - Turn left onto **Kent Ridge Crescent** to enter the NUS campus
 - After the bus stop at the Museum, turn left onto **College Link**
 - Cross the bridge onto Create Way and go straight past the bus stop
 - Turn left after the bus stop and left again to the drop-off point/ taxi stand or
- Proceed straight to roundabout and (slight right) down the ramp to the car park

From the drop-off point/taxi stand, walk down the flight of stairs (between the Enterprise wing and Innovation wing) and walk across the CREATE Plaza to the CREATE Tower (across from Korean restaurant). Take the escalator to level 2. **From the car park**, take the lift to level 2 and proceed to the security counter.

At the security counter, exchange a photo identification card for a visitor pass. Take the lift to our reception desk at level 6.



A Pick-up / Drop-off & Taxi stand

B Ramp down to the car park

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Additional information on FCL and its research programmes can be found in our Yellow Book:
<https://polybox.ethz.ch/index.php/s/87jPqlq6EZulu>

Or online: <http://www.fcl.ethz.ch>

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