



5 - 8 DECEMBER 2022
DUBAI WORLD TRADE CENTRE

MANAGING SYSTEMS TO ACHIEVE SUSTAINABLE CITIES

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Urban Design & Landscape
December 6, 2022





The Sustainable City



Talks
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SYSTEMS SYNERGY

to achieve

The Sustainable City



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Resource



Manufacturing



Construction



Operations



Demolition &
Waste



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Demolition &
Waste



Resource

SIMPLE!



Manufacturing



Construction



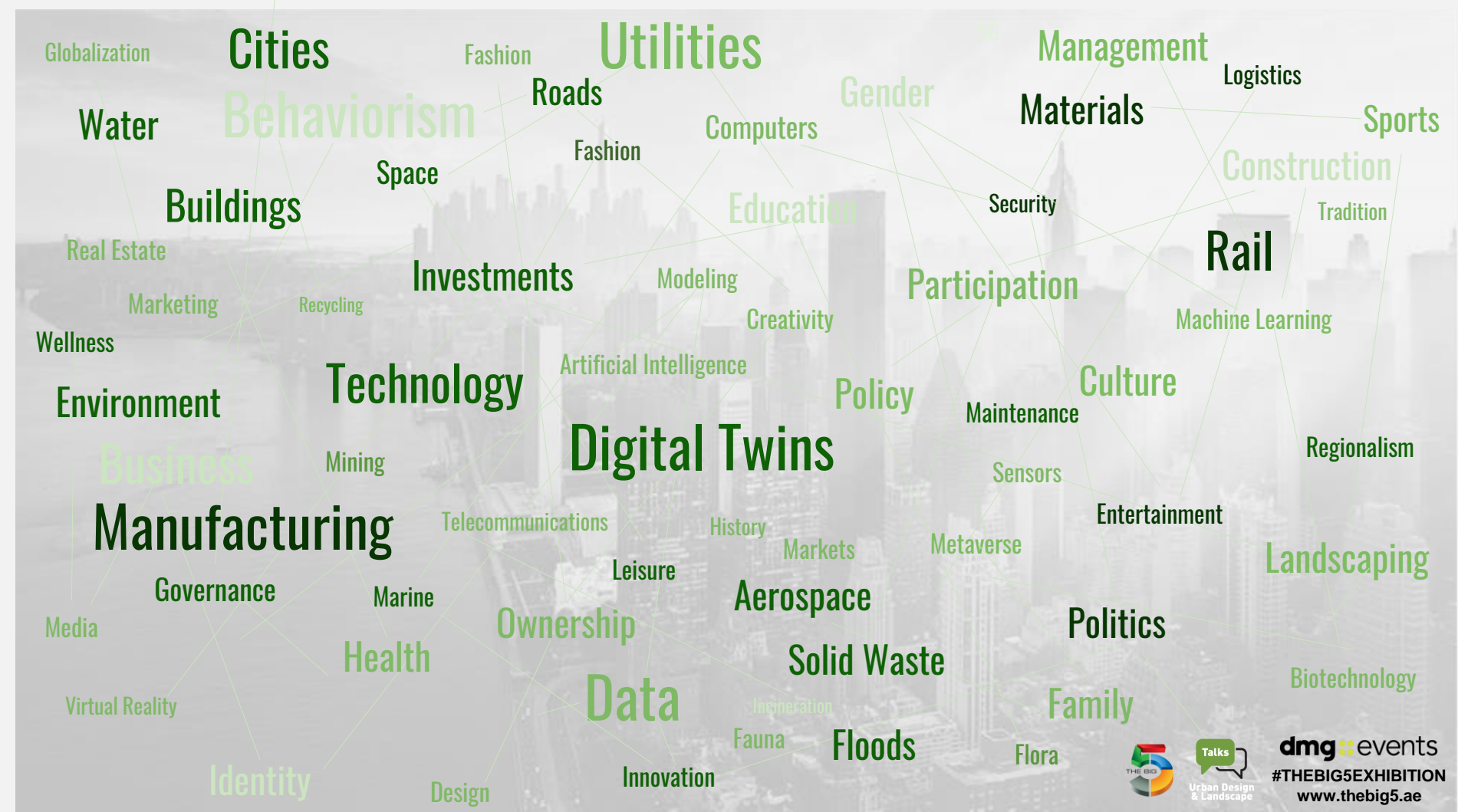
Operations



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Cities

Utilities

Management

Behaviorism

Roads

Gender

Materials

Logistics

Sports

Water

Computers

Fashion

Construction

Buildings

Space

Education

Security

Tradition

Rail

Investments

Modeling

Participation

Machine Learning

Real Estate

Wellness

Marketing

Recycling

Creativity

Artificial Intelligence

Policy

Culture

Environment

Technology

Digital Twins

Maintenance

Regionalism

Business

Mining

Sensors

Entertainment

Manufacturing

Telecommunications

History

Markets

Metaverse

Landscaping

Media

Governance

Marine

Leisure

Aerospace

Politics

Ownership

Solid Waste

Biotechnology

Health

Data

Incineration

Floods

Family

Virtual Reality

Identity

Design

Innovation

Fauna

Flora



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SMART CITIES INDEX REPORT



Smart City Index



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SYSTEMS THINKING




SUSTAINABILITY FRAMEWORK





Urban Form

-  Footprint
-  Blocks
-  Orientation
-  Zoning

- Form & Opening 
- Orientation 
- Material 
- Use 



Buildings



Superstructures Infrastructures



Hard

-  Transport
-  Power
-  Water
-  Waste
-  Communication

- Healthcare 
- Education 
- Security 
- Data 
- Culture 



Soft

SYSTEMS

How does systems integration
increase reliance on renewables?



SYNERGY

How does systems integration
decrease demand for resources?



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01

• • •

Recognize the Complexity
of Systems Integration

02

• • •

Framework to Outline Levels
of Influences Among Systems

03

• • •

Can't Solve All Problems: Need
for Prioritization and Leveraging

04

• • •

Synergy is Less Demand for
Resources and More Contribution
From Renewables



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Footprint

Manhattan Island, USA

Urban growth may be restricted by topography, water bodies or soil conditions

"Manhattan density is 27,544 pp/km2, one of the highest in the world!"

Typical Manhattan block is 80 m x 275 m

Busiest and longest subway network in North America: 1,070 km length, 25 routes with fast track lines, 493 stations

302 skyscrapers (top 3 highest residential towers in the world)

Cultural capital, global centre for the arts, design, media, fashion, tourism...



Zoning

Allowing high density development reduces sprawl and mixed-use reduce pressure on virgin land



Transport

Public transport systems reduce congestion due to population density

Blocks

Human-scale blocks enable pedestrian circulation and decrease reliance on cars



Security

Advanced surveillance reduce the heightened security risks due to increased population



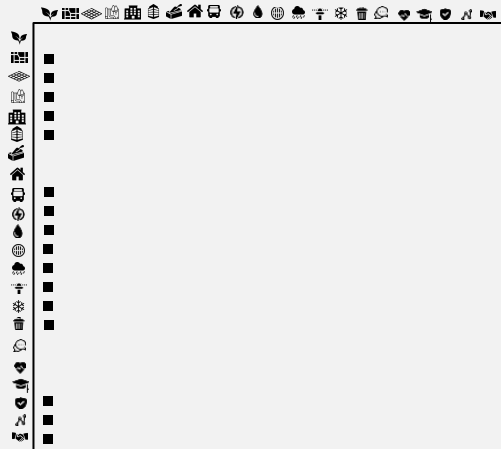
Form & Opening

Skyscrapers allow development to grow vertically with minimal land resource



Culture

Urban culture ensures liveability in high population density areas



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Water

Riyadh City, KSA

Water scarcity is a major global challenge in the 21st century

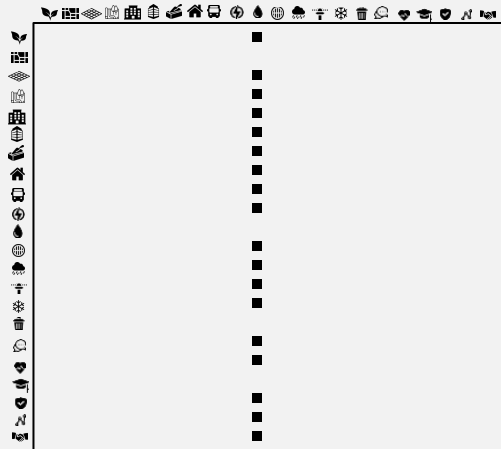
KSA demand for water is 17.4 BCM (2019) and increasing 7% annually

“KSA is the biggest producer of desalinated water in the world, an energy intensive and unsustainable industry

US EPA estimates water network leakages up to 1 trillion gallons of water annually

Residential, Commercial and Public buildings consume up to 60% of total water resources (US)

Water consciousness includes installing high-efficiency fixtures, taking short showers, installing meters, using xeriscaping...



Footprint

Urban sprawl increases need for investments in water supply infrastructure

Form & Opening

Building designs glass facades increase the need for water for interior space cooling; high-efficiency fixtures save water

Education

Raising social awareness over efficient water use practices can influence sustainability

Data

Analysing spatialized data helps identify overconsumption causes and predict future demands

Communication

Installing water sensors and meters in networks helps monitor water consumption and network leakages

Irrigation

Irrigation systems that use TSE water reduce the pressure on water sources



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Urban Form

Msheireb Downtown, Qatar

“World’s first sustainable downtown regeneration project targeting LEED Gold certification (Communities)”

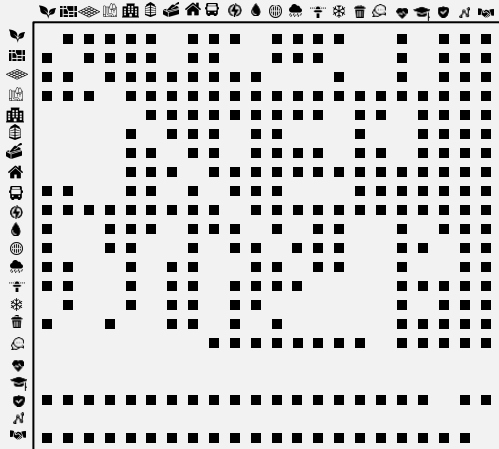
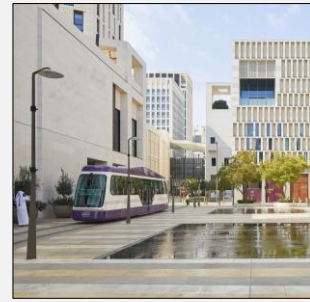
Msheireb has 32 LEED Platinum & 42 LEED Gold certified Buildings

General built-up to land area ratio (FAR) averages 350% (high density)

Typical block dimensions range between 80 m and 200 m

Mixed use district featuring residential, retail, hospitality, education, museums, civic and religious buildings

“Adopts latest in Smart City technologies”



Footprint

Compact urban footprint reduces demand for land resource and networks and increases renewables impact

Orientation

North-south oriented blocks enable better environmental performance of buildings and reduce demand for energy

Blocks

Optimally sized blocks allow eco-efficient building design, encourage walkability, and improve well-being

Zoning

Mixed-Use districts reduce travel reliance and create more robust and vibrant streetscapes

Transport

Light rail and bus networks reduce carbon emissions and improve liveability

Culture

Qatari-inspired architecture reinforce local identity and social cohesion



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Buildings

NUS School of Design, Singapore

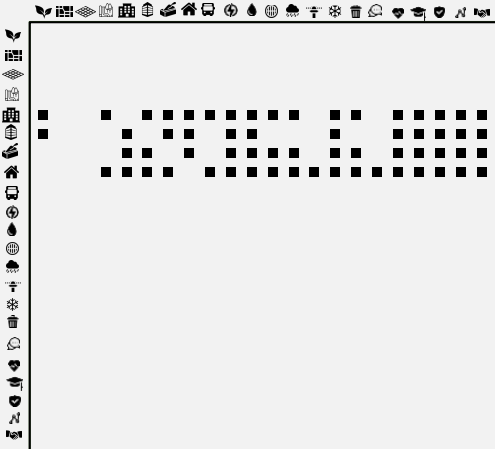
“First Net-Zero energy building in Singapore, consumes as much energy as it generates through 1200 PV panels installed on the roof”

HVAC systems typically use 60% of a building’s energy in a tropical climate

Flexible spaces in a transparent envelope allow 50% of floor space to be naturally lit and ventilated

Occupants are given options to control natural ventilation, shading devices to ensure comfort “High levels of user acceptance and wellbeing...”

Educational boards inform users of building environmental performance and resource savings



Form & Openings

Compact volume and large openings reduce material demand and increase solar & wind use

Orientation

Optimal orientation increases contribution of renewables to building operations

Materials

Locally sourced materials minimize carbon footprint and improve env. performance

Use

Educational institute uses less power and building management mitigate operational impacts

Education

Information on building passive design techniques and operational resources and waste emissions teaches users on sustainability

Water

Water recycling used for irrigation and flushing reduces pressure on water resources



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Power

Solar Parks, UAE

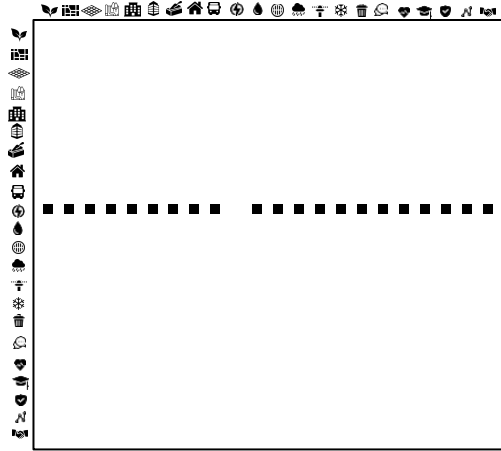
Al-Maktoum is one of the world's largest solar plants at 1.3 GW peak capacity, consisting of PV and CSP generation

Solar panel's carbon footprint is 20x less than a typical coal-powered electricity source

Electric cars emit between 40%-85% less carbon in total lifecycle compared to a petrol car

District cooling systems save between 20%-80% energy compared to both efficient and conventional systems

US EPA estimates 15% household savings in heating and cooling using well insulated building envelopes



Transport

Conversion of all private and public fleet to electrical power

Healthcare

Improved public health due to better air quality and reduced air pollution

District Cooling

Renewable power encourages district cooling systems that save energy

Orientation

Installing solar panels influences buildings orientations towards southern exposures to increase renewable energy potential

Materials

Use of insulation and low U-value materials to limit heat gains and conserve indoor temperatures

Waste

Solar power reduce carbon emissions and contribute to net-zero targets



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Waste

CopenHill WTE Plant, Denmark

Waste-to-Energy creates valuable low-carbon energy

“Four ton of garbage equal 1 ton of oil and 1.6 tons of coal”

Sweden sends only 1% of its annual waste to landfills (52% converted to energy and 47% gets recycled)

Sweden has 34 WTE plants; energy generated heats and lights 1.25 M and 680k homes respectively

Global waste recycling economy was estimated at 457 Billion USD in 2020, projections to grow at 9% in the next 5 years

Eco-friendly products containing recycled materials are the new fashion!



Footprint

Diverting waste from landfills reduces built environment footprint and pollution impacts

Power

Incineration produces renewable energy reducing need for raw resources

Materials

Salvaged materials can be upcycled and reused in other processes

Healthcare

Reduction in landfill areas improves public health and wellbeing (and adds a sporting activity!)

Data

Information insights onto resource usage and discard patterns to manage sustainability

Culture

Waste recycling systems positively contribute to an environmentally-conscious society



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Transport

Driverless Cars

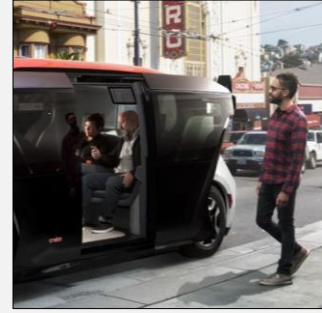
“Driverless cars will greatly improve the livability of our cities...”

Human errors are responsible for 94% of all traffic accidents.

Autonomous vehicles are expected to free up to 50 minutes per day for each traveler.

Driverless trucks are projected to increase productivity by over 200%.

US Department of Energy says automated vehicles could reduce fuel consumption for passenger cars by as much as 90% or increase it by more than 200%.



Navigation icons: Home, Back, Forward, Search, etc.

Healthcare

Less car-related incidences since mobility is automated; increased safety

Communications

Reliance on 5G communication technology for navigation creates more resource-efficient vehicles

Power

Access to alternative green fuels or renewable energy to power engine; reduced overall energy consumption

Security

Data collected on vehicle routes and activities can improve responses to hazards/danger



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01

...

There's No Such Thing
as a Sustainable City

02

...

Circularity and Integration Breed
Complex Systems That Require
Frameworks to Manage

03

...

Problem Solving is Recognizing
Priorities and Creating Synergies
to Improve Performance

04

...

Quantification of 'Sustainability' &
Identifying Untapped Systems
Potentials



THANK YOU

Talks

Concrete

Talks

Facilities
Management

Talks

Geotechnical
& Engineering

Talks

HVAC R

Talks

Offsite
& Modular

Talks

Project
Management

Talks

Solar

Talks

Stone Design

Talks

Technology

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