A dialogue on
Realizing Smart Cities

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Economic Research Institute for ASEAN and East Asia

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ERIA - Who We are?

• The Economic Research Institute for ASEAN and East Asia (ERIA) is an international organization, established by a formal agreement among 16 head of governments in 2007, to provide support to ASEAN and East Summits through policy research.

• Three Pillars of Research: (1) Deepening Economic Integration (2) Narrowing Development Gaps (3) Sustainable Development

• Capacity building: Seminars & Workshops for senior policy makers, administrators, researchers and business managers to strengthen the link between research and policy making.
Realizing Smart City

• Integrated Research and Capacity City Development Program (2019-2021)

• There are many initiatives worldwide on smart cities. However, there appears to be no clear guidelines to assist aspiring cities to become smart. Therefore, there is a need for a study not only to conduct a need and gap analysis of converting a city into a smart city, but also a procedure to assist the cities in this direction.

• Objectives
  (a) Measuring the smartness of a city through the use of Key Performance Indicators
  (b) Examine the economics of smart cities: estimation of the technology deployment costs and socio-environmental benefits of introducing various smart measures
  (C) Analyze the policy gaps/integration needed.

• The scope of sectors areas and the measures

• 5 Service delivery areas (i) Energy (ii) Mobility (iii) Waste (iv) Water and (v) ICT related issues; Emission reduction opportunities
Why we need smart cities?

What constitutes a smart city?

How to measure the Smartness?
Urban Demography and Agglomeration in ASEAN

Urban share of country’s population, 2015–2025

<table>
<thead>
<tr>
<th>Country</th>
<th>2015</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Brunei Darussalam</td>
<td>77</td>
<td>80</td>
</tr>
<tr>
<td>Malaysia</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>Indonesia</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>Thailand</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Philippines</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Laos</td>
<td>39</td>
<td>48</td>
</tr>
<tr>
<td>PDR</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>Myanmar</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Cambodia</td>
<td>24</td>
<td>56</td>
</tr>
</tbody>
</table>

This would add 70 million people to urban areas

ERIA (Economic Research Institute for ASEAN and East Asia)
### Mega cities and Second Tier cities are Growing Faster in ASEAN

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Mega Regions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 million and above</td>
<td>5.0</td>
<td>5.5</td>
<td>8</td>
<td>33%</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Large Middleweights</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 million – 5 million</td>
<td>5.7</td>
<td>6.9</td>
<td>184</td>
<td>32%</td>
<td>48%</td>
</tr>
<tr>
<td><strong>Small Middleweights</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500,000 – 1 million</td>
<td>4.8</td>
<td>5.8</td>
<td>191</td>
<td>16%</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Small Regions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300,000 – 500,000</td>
<td>5.0</td>
<td>6.0</td>
<td>143</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td><strong>Rural Regions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 300,000</td>
<td>4.2</td>
<td>5.5</td>
<td>448</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5.1</td>
<td>6.0</td>
<td>974</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Desk Analysis with ASEAN economic data base
Sustainability Challenges Will be Won or Lost in Cities
## Living Functionalities and Social Inclusion in cities

### Increasing Inequalities

<table>
<thead>
<tr>
<th>City</th>
<th>Year</th>
<th>Gini Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiangmai</td>
<td>2014</td>
<td>0.58</td>
</tr>
<tr>
<td>Ho-chie Minh City</td>
<td>2011</td>
<td>0.53</td>
</tr>
<tr>
<td>Bangkok</td>
<td>2012</td>
<td>0.53</td>
</tr>
<tr>
<td>Davo</td>
<td>2009</td>
<td>0.44</td>
</tr>
<tr>
<td>Kula Lumphur</td>
<td>2009</td>
<td>0.41</td>
</tr>
<tr>
<td>Nonthaburi</td>
<td>2006</td>
<td>0.41</td>
</tr>
<tr>
<td>Manila</td>
<td>2006</td>
<td>0.40</td>
</tr>
</tbody>
</table>

### Reduced Urban Poverty

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>% of urban population</th>
<th>Year</th>
<th>% urban population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>1996</td>
<td>13.6</td>
<td>2015</td>
<td>8.8</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1994</td>
<td>21.8</td>
<td>2015</td>
<td>6.7</td>
</tr>
<tr>
<td>Thailand</td>
<td>1990</td>
<td>20.5</td>
<td>2011</td>
<td>9</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>1995</td>
<td>25.1</td>
<td>2014</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: UN, ADB and ASEAN data base
Improving quality and availability of e-governance services

UN E Government Development Index

 EGDI is a weighted average of normalized scores on the three dimensions of e-government viz, scope and quality of online services, status of ICT infra and inherent human capital
What is a smart city? Definitions

- Adopting ICT in order to enhance livability, workability and sustainability (Smart Cities Council, 2013).
- A city where the conditions of all its critical infrastructures are monitored and integrated. (US Office of Scientific and Technical Information, 2014).
- An instrumented, interconnected and intelligent city (IBM, 2010).
- A city seeking to address public issues via ICT-based solutions on the basis of multi-stakeholder and municipality-based partnership (European Parliament, 2014).
- A city that links physical capitals with social one in order to enhance the quality of services (Corriea and Wunstel, 2011).
- Integrating the physical, IT, social and business infrastructures into a single framework so as to leverage the collective intelligence of a city (Harrison et al., 2016).
- A innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects (UNECE, 2017).
- Automating routine functions as well as monitoring and planning the city to improve the efficiency, equity and quality of life for its citizens (Batty et al., 2018).
- Smart city is not about technology. It is really about how we apply ICT to enhance the quality of life of our citizens, to create greater opportunities for every one to prosper and thrive in this new world where economic restructuring is occurring and technology diffusion is occurring at an unprecedented pace and, to also strengthen community cohesion, quality of life. Opportunities and communities. Technology is a means to that end (Vivian Balakrishnanan, Singapore Minister, 2018).
What is a Smart City? Application Types in ASCN

- Smart Government: 22%
- ICT and Big Data: 16%
- Smart Environment: 13%
- Smart Mobility: 11%
- Smart Economy: 9%
- Smart Living: 7%
- Smart People: 4%
- Others: 2%

Source: Desk Analysis of ASEAN ASCN-e book
ASEAN Smart City - Will it be a best option to Resolve New and Multiple Challenges of Service delivery?

Public safety
Health care
Design for welfare

Smart living

E-government
E-procurement
Transparency

Smart Governance

Innovation,
Entrepreneurship.
Digital education

Transport logistics
Facility management
Sharing mobility

Smart mobility

Digital education
Human capital mgt
E-democracy

Smart People

Renewable energy
Waste management
Water management

Smart Environment

Source: ASCN – e-book
What could be a Smart City Architecture?

SMART CITY ARCHITECTURE AND VALUE CHAIN

CAPTURE
SENSOR LAYER
- ELECTRICITY
- TRAFFIC
- HEALTH

TRANSIT
NETWORK LAYER
- LTE
- WIMAX
- 3G
- BLUETOOTH
- ZIGBEE
- WI-FI

ANALYSE
ANALYSIS LAYER
- DATA CENTRE
- HISTORICAL DATABASE
- DATA INTEGRATION

- COMPLEX EVENT PROCESSING
- PATTERN RECOGNITION
- PREDICTIVE MODELING
- CORRELATION ANALYSIS

PRESENT
APPLICATIONS LAYER
- DISASTER MANAGEMENT
- HEALTH MONITORING
- SUPPLY CHAIN MANAGEMENT
- ENERGY EFFICIENCY
- SECURITY MANAGEMENT
- TRAFFIC & TRANSPORTATION

ARCHITECTURE

VALUE CHAIN
SMART MODULE
SMART OBJECTS & DEVICES
NETWORK OPERATION & MANAGEMENT
BIG DATA ANALYTICS
CLOUD SOLUTIONS
PLATFORM PROVIDER
SMART CITY - AS-A-SERVICE

SYSTEM INTEGRATOR

STRATEGY AND COLLABORATION

Source: PricewaterhouseCoopers (PwC)
A common Minimum Technology Road Map for a Model Smart City

Information Technology

Communication Technology

Data Storage Management

Data Storage

Integration Platform

Data Display/Dashboard

Sensor

Controller

Activator

Data

Action

City Social Infrastructure-based Sectors

Energy
Transport
Water
Waste

Interaction

Service-based Sectors

Energy
Transport
Water
Waste

Build Environment

<---- Interaction ---->
The overall objective is to examine how cities can embark into a smart city program. This would be done by first assessing their level of smartness and then estimating the costs and benefits of becoming smart.
Key Performance Indicators

<table>
<thead>
<tr>
<th>1. General – Socio-economic indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. ICT</td>
</tr>
<tr>
<td>3. Energy</td>
</tr>
<tr>
<td>4. Transport</td>
</tr>
<tr>
<td>5. Water</td>
</tr>
<tr>
<td>6. Waste</td>
</tr>
<tr>
<td>7. Economy</td>
</tr>
<tr>
<td>8. Society &amp; Culture</td>
</tr>
<tr>
<td>9. Environment</td>
</tr>
</tbody>
</table>

- Each dimension has 2 indicator types:
  - **Core indicators**: these can be used by all cities universally.
  - **Advanced indicators**: these may be used by some cities depending on their economic capacity, social capital, environmental conditions, etc.

Some of the advanced indicators are very “smart” and can be addressed by cities that are already ahead in their smartness journey. These indicators are optional, especially for self-benchmarking.
## Total 70 Key Performance Indicators (KPIs) – Pre-chosen criteria / Fuzzy Logic

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Core</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>ICT</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Energy</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Transport</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Water</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Waste</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Economy</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Society &amp; Culture</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Environment</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>49</td>
<td>21</td>
</tr>
</tbody>
</table>
### Singapore Smart City KPI

- **ICT Dimension – Inputs for Household Internet Access KPI**

<table>
<thead>
<tr>
<th></th>
<th>Household Internet Access</th>
<th>CORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>This indicator demonstrates the access to information and technology connectivity, which is generally correlated to economic prosperity, development and growth.</td>
<td></td>
</tr>
</tbody>
</table>
|   | **1.1 Total Number of Households with Internet Access**  
  *(includes fixed and mobile networks)* | 1,206,023 |
|   | **Source**  
| 1.2 | Percentage of Households with Internet Access | 91% |
| 1.3 | Target percentage of households with internet access | 98% |
| 1.4 | Target to be achieved by | 2025 |
# Measuring the Smartness of Singapore

## ICT Dimension – Outputs for Household Internet Access KPI

<table>
<thead>
<tr>
<th>Current Level of Smartness</th>
<th>Future Targets</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>91%</strong> 2017</td>
<td><strong>98%</strong> 2025</td>
<td>To achieve the future target of <strong>98%</strong> households with internet access. The total number of households with internet access must increase to <strong>1,298,794</strong> households by <strong>2025</strong>.</td>
</tr>
</tbody>
</table>

![Diagram showing current and future levels of smartness](chart.png)
Measuring the Smartness of Singapore

- Energy Dimension – Outputs for RE Consumption KPI

<table>
<thead>
<tr>
<th>Current Level of Smartness</th>
<th>Future Target</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2018</td>
<td>2030</td>
</tr>
<tr>
<td>1%</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>

To achieve the future target of 25% energy consumed in the city, the total renewable energy generation in the city must increase to 12,612.23 GWh/year by 2030.

ERIA
**Economics of Becoming Smart City – Chiang Mai**

Energy Consumption in BAU vs Chiang Mai Smart City Scenario (Effect of Public Transport Network)

- **BAU**
  - 2015: 525.0 ktoe
  - 2020: 588.7586.0 ktoe
  - 2025: 632.8629.7 ktoe
  - 2030: 752.8749.0 ktoe

- **CMSC**
  - 2015: 525.0525.0 ktoe
  - 2020: 588.7586.0 ktoe
  - 2025: 632.8629.7 ktoe
  - 2030: 752.8749.0 ktoe

Reduction 3.8 ktoe in 2030 (0.5%)
Energy Consumption in BAU vs Chiang Mai Smart City Scenario (Effect of Low-Carbon Emission Passenger Vehicles)

2030

The CMSC scenario energy consumption reduce by 16.6% of car, 54.6% of tuk tuk, 6.0% of taxi, 83.3% motorcycle, 46.1% of bus.
Preliminary Conclusions

• As of now, many smart city models in ASEAN fail to see them as part of long term, comprehensive national low-carbon transformation plans. However, their smart city strategies represent an opportunity for paradigm shift.

• The defining characteristic of ASEAN smart city model is the promotion of technological infrastructure development. ICT, Big Data and AI are indispensable dimension of critical infrastructure and service delivery.

• Strategic planning ASEAN SC models need to capitalize on both digital intelligence for energy efficiency and on the development of knowledge and innovation networks for digital inclusion.
Key Policy Challenges for ASEAN Smart Cities

• Integration of privacy protection & social intelligence securement to get reflected in Key Performance Indicators.

• Formulation of government – Industry-citizen holistic governance

• Political Rationality: Difficulty in structural Innovation rather than technological innovation

• Future Investment: High Risk and High Return-venture capital for startups/unicorns Vs big players
1. Continue to examine how cities are embarking into smart cities program - what are the current plans, performance and perceived benefits → **Measurement Metrics**

2. Assess the critical technology needs and existing financial gas in realizing smart city goals in regard to sustainability and governance parameters → **Financing Models**.

3. Sharing and exchange experience on key adjustments required in policy making in managing the transition to smart cities → **SC Guidelines**
Thank you

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