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Smart Cities Key Performance Indicators and Monitoring

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Terms of Reference (ITU-T FG-SSC)

Main tasks and deliverables:

- **Defining the role of ICTs in environmentally sustainable smart cities**, and identifying the ICT systems necessary to their development;
- **Identifying or developing a set of Key Performance Indicators (KPIs)** to gauge the success of smart-city ICT deployments;
- **Establishing relationships and liaison mechanisms** with other bodies engaged in smart-city studies and development;
- **Identifying future smart-city standardization projects** to be undertaken by its parent group, ITU-T Study Group 5;
- **Developing a roadmap for the ICT sector's contribution to Smart Sustainable Cities**, providing cohesion to the development and application of technologies and standards.

related works on Key Performance Indicators

scope and purpose:

- to assess how the use of ICTs could have an impact on the sustainability of cities to provide a ground for standardization;
- to help cities understand to what extent they may be perceived as Smart Sustainable Cities (SSC);

technical report on Key Performance Indicators

potential users:

- Cities and municipal administrations, enabling them to develop strategies and understand the progress related to the use of ICT for making cities smarter and more sustainable;
- City residents and nonprofit citizen organizations, enabling them to understand the development and progress of SSC with respect to ICT's impact;
- Development and operation organizations of SSC, helping them to fulfill the tasks of sharing information related to the use of ICT and its impact on the sustainability of cities;
- Evaluation and ranking agencies, supporting them in selection of relevant KPIs for assessing the contribution from ICT in the development of SSC

principles of selection of Key Performance Indicators

principles of selection:

- Comprehensiveness: should cover all the aspects of SSC (see definition of SSC);
- Comparability: the KPIs should be defined in a way that the assessment can be compared between different cities according to different phases of urban development;
- Availability: the KPIs should be quantitative and the historic and current data should be either available or can be easily collected;
- Independency: the KPIs in the same dimension should be independent or almost-orthogonal i.e., the smallest possible overlap;
- Simplicity: the concept of each indicator should be simple and easy to understand.

definition of Smart Sustainable Cities

A smart sustainable city is an 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 and environmental aspects

ITU-T FG-SSC webpage:
http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

KPIs dimension in align with SSC definition and City Prosperity Index of UN Habitant

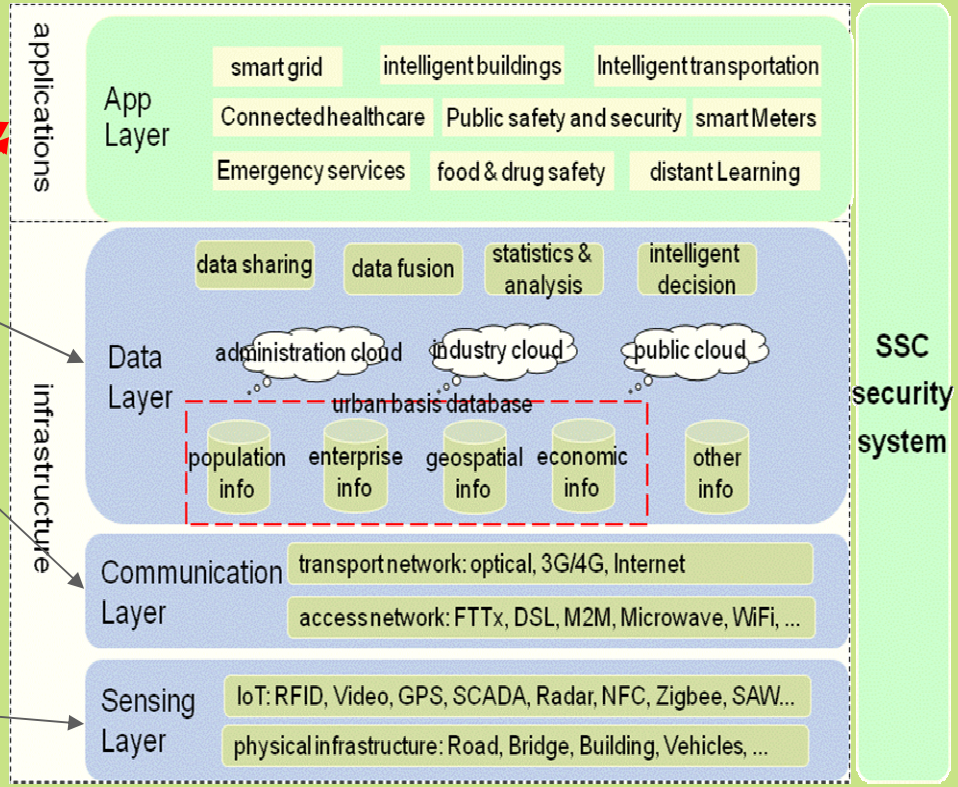
dimensions:

- ICT
- Environmental Sustainability
- Productivity
- Quality of life
- Equity and social inclusion
- Non-ICT infrastructure development

KPIs dimension mapping to technical framework of SSC

dimensions:

- ICT
- Environmental Sustainability
- Productivity
- Quality of life
- Equity and social inclusion
- Non-ICT infrastructure development



indicators of SSC

dimension	indicators
ICT	14, covering Network facilities, Information facilities
Environmental sustainability	14, covering Environment, Energy and natural resources
Productivity	12, covering Innovation, Economy sustainability
Quality of life	22, covering Convenience and comfort, Security and safety, Healthcare, Education and training
Equity and social inclusion	11, covering Openness and public participation, Social sustainability, Governance sustainability
Non-ICT infrastructure development	15, covering Building, Transport, Sanitation, Municipal pipe network

some indicators of ICT dimension (1/3)

- Fixed (wired)-broadband subscriptions per 100 habitants: ITU-D ICT Development index
- Wireless-broadband subscriptions per 100 habitants: ITU-D ICT Development index
- Internet bandwidth (bit/s): ITU-D ICT Development index
- Internet access (% of households): ITU-D ICT Development index
- computer penetration (% of households): ITU-D ICT Development index

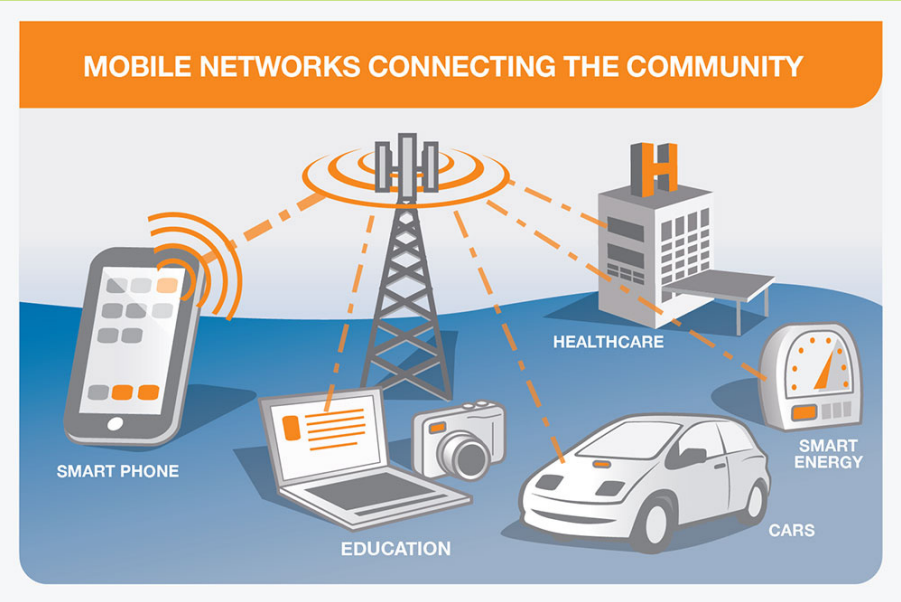
some indicators of ICT dimension (2/3)

- Proportion of business based on cloud computing: serving for enterprises, government and other organizations
- Proportion of business based on GIS (location, navigation etc.): serving for enterprises, government and other organizations
- cyber-security
  - level of cyber-security
  - level of child-online-protection
- Internet access (% of households): ITU-D ICT Development index

KPIs work also reflecting the recent progress of FG-SSC!

some indicators of ICT dimension (3/3)

- EMF Considerations (Design Efficiency, Safety Compliance and Consumer Information): 10 point checklist



No	Smart Sustainable City - EMF Checklist	Check
1	**EMF Compliance Framework** Ensure an EMF compliance framework is established to protect the general public and workers from the adverse effects of EMF.	☐
2	**ICT devices meet ICNIRP RF EMF exposure guidelines** Ensure that devices are assessed for compliance with the public exposure guidelines.	☐
3	**Wireless networks meet ICNIRP RF EMF exposure guidelines** Ensure that the network sites are assessed for compliance to the ICNIRP guidelines, and that access controls and safety procedures are in place for working at antenna sites.	☐
4	**Document RF EMF Compliance** Ensure the EMF compliance for the ICT devices and networks is documented.	☐
5	**Base station antennas are selected to suit the ICT network requirements** Ensure that the appropriate base station antennas are used to improve ICT efficiency, provide services and integrate with the environment.	☐
6	**Wireless network antennas are located in close proximity to the ICT devices** Ensure that network and base station antennas are located where the ICT devices are being used. This is essential to improve coverage and efficiency, and reduce the signal levels from the network and devices.	☐
7	**Planning legislation incorporates ICT networks and antenna requirements -** Ensure more efficient deployment of ICT systems by a consistent approach to planning approval.	☐
8	**EMF ICT compliance information is available** Ensure EMF compliance information is available.	☐
9	**General EMF Information is available to the community** Ensure information reference for EMF information is the WHO and ITU resources.	☐
10	**Existence of Wireless Network Information Program** Ensure availability of information based on credible sources and using appropriate communication channels addressing compliance, health concerns and siting.	☐

some indicators of None-ICT development dimension (1/3)

- Application level of energy saving technologies in public buildings:
- Percentage of public buildings with integrated technologies:
- Proportion of smart home automation adoption:
- Coverage of installation of road sensing terminals:
- Coverage of parking guidance systems:
- Coverage of electronic bus bulletin board

some indicators of None-ICT development dimension (2/3)

- Proportion of sewage under automatic inspection:
- Improvement of waste water recycling with ICT measures:
- Proportion of drainage system under automatic inspection:
- Proportion of lighting system under automatic inspection:
- Proportion of gas system under automatic inspection:
- Proportion of water supply system under automatic inspection
- Proportion of power supply system under automatic inspection
- Improvement of underground pipelines and spatial integrated administration with ICT measures

some indicators of None-ICT development dimension (2/3)

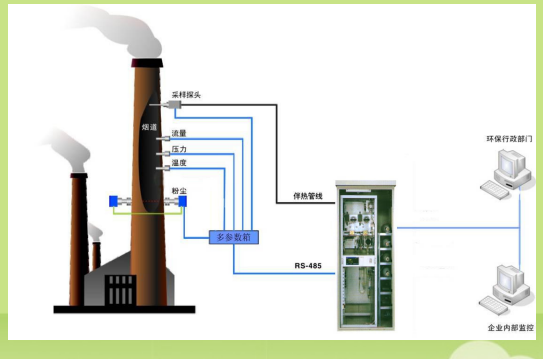
- Improvement of underground pipelines and spatial integrated administration with ICT measures

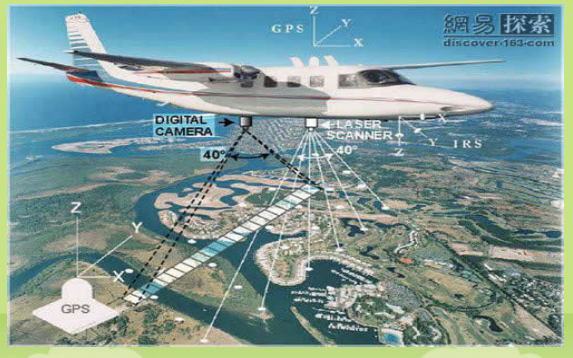





some indicators of Environmental sustainability dimension (1/2)

- water:
  - Progress degree of ICT in the protection of city water resources
  - Effect of flood control monitoring by means of ICT measures
  - Proportion of water pollution control by means of ICT measures
- air pollution monitoring:
- toxic substances monitoring:
- noise monitoring:
- Solid waste disposal management:





some indicators of Environmental sustainability dimension (2/2)

- level of electricity usage with ICT measures:
  - civilian/per capita
  - industrial/per GDP
- level of water usage with ICT measures:
  - civilian/per capita
  - industrial/per GDP
- level of fossil fuel industrial usage with ICT measures (per GDP):
- level of rare/nobel metal usage with ICT measures (per GDP):

some indicators of Productivity dimension

sub-dimension	indicator
Innovation	Percentage of R&D expenditure in GDP
	Ratio of knowledge-intensive enterprises
	Revenue share of knowledge-intensive enterprise
	Patent number per 100,000 inhabitant
Economy sustainability	Employment rate in knowledge-intensive sectors
	Percentage of e-commerce transaction amount
	.....

some indicators of Quality of life dimension (1/2)

sub-dimension	indicator
Convenience and comfort	Satisfaction with online commercial and financial services
	Satisfaction with environmental safety
	Convenience of government services
	Satisfaction with crime prevention and security control
	Convenience of urban medical care
	Perception on proof against risk of poverty
	.....

data can be obtained via questionnaire

some indicators of Quality of life dimension (2/2)

sub-dimension	indicator
Security and safety	Penetration of ICT for disaster prevention
	Penetration of City video surveillance
Healthcare	Percentage of archiving electronic health records for residents
	Usage rate of electronic medical records
	Coverage rate of household e-health service
Education and training	Penetration of e-learning system
	.....

some indicators of Equity and social Inclusion dimension

sub-dimension	indicator
Openness and public participation	Immigration-friendly environment contributed by ICT measures
	Online civic engagement
Social sustainability	Feasibility of anonymous feedback online
Governance sustainability	Digital access to urban planning and budget document
	Penetration rate of government on-line services
	……

KPIs metrics and evaluation

- The centesimal system is adopted as the grading method for the set of indicators;
- Supposing each indicator's value is ranged within 0 to 100, all the 88 indicators are equally weighted, the evaluation result is:
  - Essc = (I1 + I2 +...+ I88)/88.

KPIs metrics and evaluation

- A city could quantify its effort in constructing SSC by comparing the SSC index of several years. It could also estimate its progress in various fields by examining the dimension or sub-dimension value
- The performances of different cities are also measurable. The index of SSC can be viewed as a six-dimension vector (EICT, EES, EPRO, EQL, EESI, EINF). The comparison of two cities becomes the distance measurement of two six-dimension vectors.

Links & Additional Information

- ITU-T and Climate Change
  itu.int/ITU-T/climatechange
- ITU Focus Group on Smart Sustainable Cities
  itu.int/en/ITU-T/focusgroups/ssc/
- ITU Symposia & Events on ICTs and Climate Change
  itu.int/ITU-T/worksem/climatechange

Thank YOU

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