|  |  |
| --- | --- |
|  | **International Telecommunication Union** |
|  |  |
| **ITU-T** | **FG-SSC** |
| TELECOMMUNICATIONSTANDARDIZATION SECTOROF ITU | (03/2015)  |
|  | ITU-T Focus Group on Smart Sustainable Cities |
|  | **Key performance indicators related to the use of information and communication technology in smart sustainable cities** |
|  | Focus Group Technical Specifications |



FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of tele­com­mu­ni­ca­tions, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The procedures for establishment of focus groups are defined in Recommendation ITU-T A.7. ITU-T Study Group 5 set up the ITU-T Focus Group on Smart Sustainable Cities (FG-SSC) at its meeting in February 2013. ITU-T Study Group 5 is the parent group of FG-SSC.

Deliverables of focus groups can take the form of technical reports, specifications, etc., and aim to provide material for consideration by the parent group in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

|  |
| --- |
| **SERIES OF FG-SSC TECHNICAL REPORTS/SPECIFICATIONS**Technical Report on "Smart sustainable cities: a guide for city leaders"Technical Report on "Master plan for smart sustainable cities" Technical Report on "An overview of smart sustainable cities and the role of information and communication technologies"Technical Report on "Smart sustainable cities: an analysis of definitions"Technical Report on "Smart water management in cities"Technical Report on "Electromagnetic field (EMF) considerations in smart sustainable cities"Technical Specifications on "Overview of key performance indicators in smart sustainable cities"Technical Report on "Information and communication technologies for climate change adaptation in cities"Technical Report on "Cybersecurity, data protection and cyber resilience in smart sustainable cities" Technical Report on "Integrated management for smart sustainable cities" Technical Report on "Key performance indicators definitions for smart sustainable cities"Technical Specifications on "Key performance indicators related to the use of information and communication technology in smart sustainable cities"Technical Specifications on "Key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities"Technical Report on "Standardization roadmap for smart sustainable cities"Technical Report on "Setting the stage for stakeholders’ engagement in smart sustainable cities"Technical Report on "Overview of smart sustainable cities infrastructure" Technical Specifications on "Setting the framework for an ICT architecture of a smart sustainable city"Technical Specifications on "Multi-service infrastructure for smart sustainable cities in new-development areas" Technical Report on "Intelligent sustainable buildings for smart sustainable cities" Technical Report on "Anonymization infrastructure and open data in smart sustainable cities"Technical Report on "Standardization activities for smart sustainable cities" |

© ITU 2015

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

**Key performance indicators related to the use of information and communication technology in smart sustainable cities**

Acknowledgements

These Technical Specifications were researched and authored by Ziqin Sang (Fiberhome Technologies Group), Hongqing Ding (Fiberhome Technologies Group), Masayuki Higashi (Japan), Jiro Nakamura (NTT), Minako Hara (NTT), Takafumi Hashitani (Fujitsu), Junnosuke Sugiura (Fujitsu), Claudio Di Carlo (Italy), Paola Girdinio (Genoa University), Raffaele Bolla (Genoa University), Paolo Gemma (Huawei), Dewei Xu (Fiberhome Technologies Group), Jia Guo (Fiberhome Technologies Group), Pernilla Bergmark (Ericsson), Lelio Digeronimo (Avina), Luis Castiella (San Andrés University), Mike Wood (Telstra), Jack Rowley (GSMA), Christer Tornevik (Ericsson) and Christophe Grangeat (Alcatel-Lucent) .

The authors wish to extend their gratitude to Ramy Ahmed Fathy (NTRA, Egypt), Michael Mulquin (IS Communications), Angelica V. Ospina (University of Manchester), Mythili Menon (University of Geneva) for their valuable inputs and support.

The authors acknowledge the guidance and support from all the members of the ITU-T Focus Group on Smart Sustainable Cities (FG-SSC) Management Team.

Additional information and materials relating to this Technical Specifications can be found at: [www.itu.int/itu-t/climatechange](http://www.itu.int/itu-t/climatechange). If you would like to provide any additional information, please contact Cristina Bueti (ITU) at tsbsg5@itu.int.

Key performance indicators related to the use of information and communication technology in smart sustainable cities

**Table of Contents**

 Page

1 Scope 2

2 References 2

3 Definitions 3

3.1 Terms defined elsewhere 3

3.2 Terms defined in these Technical Specifications 3

4 Abbreviations and acronyms 4

5 General principles for Key Performance Indicators (KPIs) for ICT in a city context 4

6 Key Performance Indicators 5

6.1 Sub-dimensions of KPIs 5

6.2 Key performance indicators of SSC 5

Appendix I – Additional indicators 13

Appendix II – UN habitat City Prosperity Index 15

Bibliography 17

Key performance indicators related to the use of information and communication technology in smart sustainable cities

Executive Summary

These Technical Specifications give general guidance to cities and provides for the definitions of key performance indicators (KPIs) related to the use of information and communication technology (ICT) in the context of Smart Sustainable Cities (SSCs).

These Technical Specifications are expected to become an ITU-T Recommendation and the focus will be on the application of the ICT. Other Technical Specifications, under development within the Focus Group on Smart Sustainable Cities (FG-SSC), cover the definitions of KPIs related to the sustainability impacts of ICT and are expected to become another ITU-T Recommendation.

Keywords

Information and Communication Technologies (ICTs), Smart Sustainable Cities (SSC), Sustainability Impacts, Cities

Introduction

According to the terms of reference (ToR) of the Focus Group on Smart Sustainable Cities (FG‑SSC), one of the objectives is to:

* Identify or develop a set of key performance indicators (KPIs) to assess how the use of ICTs has an impact on the environmental[[1]](#footnote-1) sustainability of cities.
* One of the specific tasks and deliverables of the FG-SSC is to:

– Develop a document of KPIs to assess the impact of the use of ICT projects in cities.

This document is one of the deliverables developed by the FG-SSC and defines the KPIs. The series of KPIs definitions deliverables include:

* Technical Specifications on overview of key performance indicators in smart sustainable cities [ITU-T L.KPIs-overview].
* Technical Specifications on key performance indicators related to the use of information and communication technology in smart sustainable cities. This document lists the KPIs focusing on ICT use in SSC.
* Technical Specifications on key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities [ITU-T L.KPIs-impact]. This document lists the KPIs proposed for ICT impact on sustainability.
* Technical Report on key performance indicators definitions for Smart Sustainable Cities [ITU-T L.KPIs-Supp]. This document provides the information regarding existing KPIs and evaluation index systems for smart cities, KPIs for sustainable cities, etc.

In this document FG-SSC proposes ICT related KPIs in alignment with the definition of SSC while considering the dimensions of such a city. This document is aligned with the framework provided by UN Habitat in its City Prosperity Index with respect to the categorization of indicators as described in Appendix II and further detailed in [ITU‑T L.KPIs‑overview].

1 Scope

These technical specifications form part of a series of Technical Reports and Technical Specifications focusing on the key performance indicators (KPIs) for smart sustainable cities (SSCs). It specifically provides the KPIs related to ICT adoption and use in the context of SSC. Evaluating these indicators can help cities as well as their stakeholders understand the extent to which they may be perceived as SSC. These Technical Specifications describe applicability of KPIs, principles and dimensions as well as the definitions of corresponding indicators. To fit into the overall framework of city indicators the present Technical Specifications re-use the categorization of UN Habitat´s City Prosperity Index.

These Technical Specifications can be utilized by:

* Cities and municipal administrations, including the SSC-relevant policy-making organizations, and government sectors, enabling them to develop strategies and understand the progress related to the use of ICT for making cities smarter and more sustainable.
* City inhabitants and their non-profit organizations, enabling them to understand the development and progress of SSC.
* Development and operation organizations of SSC, including planning unit, SSC-related producers and service providers, operation and maintenance organizations, helping them to fulfill the tasks of sharing information related to the use of ICT in the city.
* Evaluation agencies and academia, supporting them in selection of relevant KPIs for assessing the contribution from ICT in the development of SSC.

The intention of identifying the KPIs is to establish the criteria to evaluate ICT´s contributions in making cities smarter and more sustainable, and to provide the cities with the means for self-assessments. It is desirable that cities can quantify their achievement according to their goals.

These Technical Specifications list the core indicators that are chosen to be applicable for all cities. The goals for moving towards increased smartness and sustainability differs between cities. Thus, based on their economic power or/and population growth etc, the cities can also select appropriate indicators among those listed in Appendix I and/or add new ones.

These Technical Specifications are applicable for both cities and city regions, which could be organized in different ways:

* A single city organized as one or more administrative units, or
* A union of cities in the neighboring area that can share some services.

2 References

[ITU-T L.KPIs-overview] *Technical Specifications on overview of key performance indicators in smart sustainable cities (2014)*

[ITU-T L.KPIs-impact] *Technical Specifications on key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities*

[ITU-T L.KPIs-Supp] *Technical Report on key performance indicators definitions for smart sustainable cities*

[ITU-T TR SSC Def] *Technical Report on smart sustainable cities: an analysis of definitions (2014)*

[ITU-T TR EMF Con] *Technical Report on EMF consideration in smart sustainable cities (2014)*

[UN-Habitat report] UN Habitat report (2013)*, State of the World’s cities 2012/2013 Prosperity of Cities*

[ISO 37120] ISO 37120:2014, *Sustainable development and resilience of communities – Indicators for city services and quality of life*.

[OECD KE] Organisation for Economic Co-operation and Development (1996), *The knowledge-based economy*.

3 Definitions

3.1 Terms defined elsewhere

These Technical Specifications use the following terms defined elsewhere:

**3.1.1 city** [ITU-T L.KPIs-overview]: An urban geographical area with one (or several) local government and planning authorities.

**3.1.2 city sustainability** [ITU-T L.KPIs-overview]: The sustainability of smart city is based on four main aspects:

* economic: The ability to generate income and employment for the livelihood of the inhabitants.
* social: The ability to ensure well-being (safety, health, education etc) of the citizens can be equally delivered despite differences in class, race or gender.
* environmental: The ability to protect future quality and reproducibility of natural resources.
* governance: The ability to maintain social conditions of stability, democracy, participation, and justice.

**3.1.3 knowledge economy**[OECD KE]: Economies which are directly based on the production, distribution and use of knowledge and information.

**3.1.4** **smart sustainable cities** [ITU-T TR SSC Def]: 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.

3.2 Terms defined in these Technical Specifications

These Technical Specifications define the following terms:

**3.2.1 big data**: Big data includes a set of techniques and technologies that require new forms of integration to uncover large hidden values from large data sets that are diverse, complex, and of a massive scale in SSC.

**3.2.2 ICT companies**: Companies which provide products and/or services with respect to Information and Communication Technologies.

4 Abbreviations and acronyms

These Technical Specifications use the following abbreviations and acronyms:

COP Child Online Protection

DSL Digital Subscriber Line

EMF Electromagnetic Field

GDP Gross Domestic Product

GHG Greenhouse Gas

GIS Geographic Information System

ICT Information and Communication Technology

IDI ICT Development Index

ISO International Organization for Standardization

ITU International Telecommunication Union

KPI Key Performance Indicator

LAN Local Area Network

SSC Smart Sustainable City

UN-Habitat United Nations Human Settlements Programme

WHO World Health Organization

5 General principles for Key Performance Indicators (KPIs) for ICT in a city context

The selection of KPIs is based on the following principles:

* **Comprehensiveness**: The set of indicators should cover all the aspects of SSC. The indicators of evaluation should be aligned to the measured subject, i.e., ICT and its impact on the sustainability of cities. The index system should reflect the level of general development in a certain aspect.
* **Comparability**: The KPIs should be defined in a way that data can be compared scientifically between different cities according to different phases of urban development, which means the KPIs must be comparable over time and space. It should also be possible to extend and amend the set of KPIs according to the actual development.
* **Availability**: The KPIs should be quantitative and the historic and current data should be either available or easy to collect.
* **Independence**: The KPIs in the same dimension should be independent or almost-orthogonal i.e., overlap of the KPIs should be avoided as much as possible.
* **Simplicity**: The concept of each indicator should be simple and easy to understand. Also the calculation of the associated data should be intuitive and simple.
* **Timeliness**: The ability to produce KPIs with respect to emerging issues in SSC construction.

6 Key Performance Indicators

6.1 Sub-dimensions of KPIs

The sub-dimensions for each dimension are recorded in Table 1. These have been tailored from the Table 1 of [ITU-T L.KPIs-overview].

In the table below each dimension is identified by the letter Dx. The sub-dimensions are then classified by the label Dx.y where x denotes the dimension and Y maps to sub-dimension.

Table 1 – Sub-dimension of KPIs

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension label | Dimension | Sub-dimension[[2]](#footnote-2) label | Sub-dimension |
| D1 | Information and Communication Technology | D1.1 | Network and access |
| D1.2 | Services and Information platforms |
| D1.3 | Information security and privacy |
| D1.4 | Electromagnetic field |
| D2 | Environmental sustainability | D2.1 | Air quality |
| D2.5 | Water, soil and noise  |
| D3 | Productivity | D3.1 | Capital investment |
| D3.4 | Trade |
| D3.8 | Innovation |
| D3.9 | Knowledge economy |
| D4 | Quality of life | D4.1 | Education |
| D4.2 | Health |
| D4.3 | Safety/security public place |
| D5 | Equity and social inclusion | D5.3 | Openness and public participation |
| D5.4 | Governance |
| D6 | Physical infrastructure  | D6.1 | Infrastructure/connection to services – piped water |
| D6.2 | Infrastructure/ connection to services – sewage |
| D6.3 | Infrastructure/ connection to services – electricity |
| D6.8 | Infrastructure/connection to services – road infrastructure |
| D6.11 | Building |

6.2 Key performance indicators of SSC

This part of the Technical Specifications defines the core indicators applicable for all cities that want to become a SSC.

Each indicator is labeled (Ix.y.z), where (i) x denotes the dimension, (ii) y the sub-dimension and (iii) z the indicator.

The indicators listed in Appendix I are proposed as additional indicators for consideration. Cities can select appropriate ones among those, and/or add new indicators, to evaluate the contributions of ICT to their SSC goals.

NOTE – In this text the *e-service* concept (e.g., e-health and e-governance etc) is used in an inclusive way and refers to both wired and wireless services that benefit the cities and city inhabitants. The mobile wireless services could also be referred to as *m-services* (e.g., m-health, m-banking etc.). These ICT services and goods are also collectively known as *Smart services* (e.g., Smart grid, Smart lighting) and *Smart goods* (e.g., Smart meters). In some cases the Smart service/ goods concept is used instead of *e-service* if this terminology is more widely adopted for the referred service or goods.

Note: In this document the term *city inhabitant* is used to refer to the people living in the city.

### 6.2.1 ICT

This clause lists the core indicators defined for ICT dimension.

There are 11 indicators in this dimension, covering *computer penetration, Internet access, fixed (wired)-broadband subscriptions, wireless-broadband subscriptions, social media, information security, COP, privacy protection, and EMF consideration in cities etc*.

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D1.1 Networks and access | I1.1.1 Availability of computers or similar devices | Proportion of households with at least one computer or similar device (tablet, smart phones, etc.) (\*) |
| I1.1.2 Availability of Internet access in households | Proportion of households with Internet access for any household member via a fixed or mobile network at any given time. (\*) |
| I1.1.3 Availability of fixed broadband subscriptions  | Fixed (wired) broadband subscriptions per 100 inhabitants. (\*)NOTE – Fixed (wired) broadband subscriptions refer to subscriptions for high-speed access to the public Internet (a TCP/IP connection). High-speed access is defined as downstream speed equal to, or greater than, 256 kbits/s. Fixed (wired) broadband includes broadband through cable modem, DSL, fiber and other fixed (wired) broadband technologies (such as Ethernet LAN, and broadband-over-power line (BPL) communications). Mobile cellular network subscriptions are not included. |
| I1.1.4 Availability of wireless broadband subscriptions | Wireless-broadband subscriptions per 100 inhabitants (\*) NOTE – Wireless broadband subscriptions include wireless broadband through satellite broadband, terrestrial fixed wireless broadband and mobile cellular network subscriptions. |
| D1.2 Services and information platforms | I1.2.1 Use of social media by the public sector | Use of social media by the public sector, to share information about regulations and to get feedback. NOTE – Social media refers to a group of Internet-based applications that allow the creation and exchange of user-generated content.  |
| D1.3 Information security and privacy | I1.3.1 Information security of public services and systems | Proportion of incidents, due to illegal system access, unauthorized data storage or transmission, unauthorized hardware and software modifications, which lead to information disclosure or financial loss. |
| I1.3.2 Existence of systems, rules and regulations to ensure Child Online Protection (COP)  | Existence of rules and regulations to ensure COP. This also includes proportion of public web services and devices that ensure COP.NOTE – The city could work against cyber bullying by ensuring safety in online public services (for the use of ICT in schools etc.). |
| I1.3.3 Existence of systems, rules and regulations to ensure Privacy protection in public service | Existence of rules and regulations to ensure privacy protection in public service. This should also include proportion of public services and devices that ensure privacy protection.NOTE – This indicator evaluates the adoption of K-anonymity privacy preserving scheme, and other systems to ensure privacy of the city inhabitants. In addition, the rules, and regulations also require that institutions which offer consumers financial products or services like loans, financial advice, investment advice, or insurance; to safeguard sensitive and confidential information by explaining their information-sharing practices to their customers. |
| D1.4 Electromagnetic field  | I1.4.1 Compliance with WHO endorsed exposure guidelines | Application of WHO endorsed exposure guidelines for ICT installations in the city.[[3]](#footnote-3)NOTE – WHO endorsed exposure guidelines are referred to in [ITU-T TR EMF Con]. |
| I1.4.2 Adoption of a consistent planning approval process with respect to EMF | Application of a consistent planning approval process with respect to EMF to enable efficient deployment of ICT systems .NOTE – A consistent planning approval process between cities is preferred to individual city requirements to ensure efficient deployment. |
| I1.4.3 Availability of EMF information | Availability of information for the public and other stakeholders and referencing WHO and ITU resources regarding compliance, health and installation issues. |
| NOTE – Indicators marked by (\*) are based on ITU ICT Development Index (<https://www.itu.int/ITU-D/ict/publications/idi/index.html>) |

### 6.2.2 Environmental sustainability

This clause lists the core indicators defined for Environmental Sustainability.

There are 3 indicators in this dimension, covering *air quality, water resource, and noise monitoring etc.*

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D2.1 Air quality | I2.1.1 Application of ICT based monitoring system for particles and toxic substances | Proportion of city area covered by outdoor ICT based monitoring system for particles and toxic substances NOTE – This indicator captures to what extent ICT monitors the air pollution (PM10, PM2.5, toxic substances etc.). |
| D2.5 Water, soil and noise | I2.5.1 Application of city water monitoring through ICT | Proportion of the city water resources (rivers, lakes etc) monitored by ICT with respect to water pollution and quality. NOTE – Quality of drinking water forms part of Physical infrastructure. |
| I2.5.2 Application of ICT based noise monitoring  | Proportion of the city area with applied ICT based noise monitoring NOTE – This indicator measures how ICT is used to monitor how the city inhabitants are exposed to acoustical noise within city areas, especially focusing on noise sensitive areas. |

### 6.2.3 Productivity

This clause lists the core indicators defined for productivity and economic sustainability.

There are 8 indicators in this dimension, covering *expenditure of ICT R&D, expenditure of ICT projects, ICT companies ratio, ICT employers, intangible investment, e-commerce, e-services and cloud computing.*

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D3.1 Capital investment | I3.1.1 ICT related Research and Development expenditure | Proportion of city GDP spent on ICT related Research and Development NOTE – This covers investment in ICT related Research and Development including academic research input. |
| I3.1.2 Investment intensity in ICT projects enabling SSC | The amount of city investments in programs, initiatives and awards that enhance the smartness and sustainability of the city, expressed as proportion of city GDP. NOTE – These projects could be sponsored by grant makers, multilateral organisations and/or private sector. |
| D3.4 Trade | I3.4.1 Application of e-commerce transactions  | Number of e-commerce transactions per 100 inhabitants through electronic and mobile payment. |
| D3.8 Innovation  | I3.8.1 Research and Development intensity in ICT | Proportion of research and development intensive ICT companies among all companies.NOTE – Research and development intensive ICT companies refer to ICT companies with high focus on research and development efforts. |
| D3.9 Knowledge economy | I3.9.1 Intangible investments as a proportion of GDP | Proportion of intangible investments (e.g., Research and development, software, design, marketing, education and training) in new and existing businesses expressed as proportion of city GDP. |
| I3.9.2 Employees belonging to ICT sector | Proportion of employees in ICT among all employees.NOTE – Employees in smart industries to be added if possible. |
| I3.9.3 Companies providing e‑services | Proportion of companies which provide network based services (including e‑commerce, e-learning, e-entertainment, cloud computing etc.).NOTE – Data collection may be challenging due to data gaps. |
| I3.9.4 Application of computing platforms | Proportion of companies that offer cloud computing and similar resources serving the public, other companies, government and other organizations. |

### 6.2.4 Quality of life

This clause lists the core indicators defined for Quality of Life.

There are 7 indicators in this dimension, covering *e-learning, electronic health records, electronic medical records, sharing medical information, telemedicine, anti-disaster and other safety measures.*

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D4.1 Education | I4.1.1 Use of e-learning system | The proportion of city inhabitants using e‑learning systems. |
| D4.2 Health | I4.2.1 Use of electronic health records | Proportion of city inhabitants with electronic health records.NOTE – A health record is different from a medical record and contains information on weight, height, heart rate, BMI, etc. |
| I4.2.2 Use of electronic medical records | Proportion of city inhabitants who have electronic medical records. |
| I4.2.3 Sharing of medical resources and information among hospitals, pharmacies and other health care providers | Proportion of hospitals, pharmacies and health care providers using ICT means for sharing of medical resources such as hospital beds, and medical information, especially electronic medical records. |
| I4.2.4 Adoption of telemedicine | Proportion of patients involved in telemedicine programs including services, such as e-consultation, e-monitoring, online health care advice and guidance etc. |
| D4.3 Safety/security public place | I4.3.1 Adoption of ICT for disaster management | Adoption of an ICT based disaster management system including disaster preparedness, prevention, mitigation, and response as applicable to the city. NOTE – Disasters may be natural or man-made. |
| I4.3.2 Availability of ICT based safety systems | Availability of ICT based systems that increase the perceived safety. NOTE – This may include solutions such as video surveillance system, online information published by the police, online support for protection of women and children, community incident mapping etc. |

### 6.2.5 Equity and social inclusion[[4]](#footnote-4)

This clause lists the core indicators defined for equity and social inclusion.

There are 6 indicators in this dimension, covering *online city information, civic engagement, support for new city inhabitants, ICT literacy, online administering, and support to persons with specific needs.*

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D5.3 Openness and public participation | I5.3.1 Availability of online city information and feedback mechanisms | Proportion of city information available online and existence of ICT systems for easy access and anonymous feedback mechanism that enable cities to improve their governance.NOTE – Online city information include city plans, budget, minutes of city governance meetings etc. |
| I5.3.2 Online civic engagement | Proportion of city inhabitants using online information and proportion of city inhabitants using ICT based feedback mechanism. |
| I5.3.3 Online support for new city inhabitants | Availability of ICT based applications and services to provide establishment support for new city inhabitants.NOTE – New city inhabitants include people moving to the city and visitors |
| I5.3.4 Existence of strategies, rules and regulations to enable ICT literacy among inhabitants | Existence of strategies, regulations, voluntary work or interest organizations to enhance ICT literacy among all city inhabitants. NOTE – This includes mechanisms that enable public knowledge and skill development. |
| D5.4 Governance | I5.4.1 Provision of online systems for administering public services and facilities | Proportion of public services and facilities (e.g., choice of schools, booking of public sports facilities, library services, etc.) that could be administered online.NOTE – This includes bookings, payments etc. |
| I5.4.2 Application of services to support persons with specific needs | Proportion of public facilities and buildings that provide ICT based services and information to support persons with specific needs, and proportion of online public information customized for these persons.NOTE – Persons with specific needs here indicate indigenous people, and persons with disabilities including age related disabilities.  |

### 6.2.6 Physical infrastructure

This clause lists the core indicators defined for the physical infrastructure.

There are 13 indicators in this dimension, covering *the infrastructures including piped water, sewage, electricity, road infrastructure and building.*

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D6.1 Infrastructure/ connection to services – piped water | I6.1.1 Water supply system management using ICT | Proportion of the water supply systems under automatic monitoring using ICT so as to ensure water quality and reduce leakage. |
| I6.1.2 City fresh water sources monitored using ICT | Proportion of the city fresh water sources monitored using ICT with respect to availability. |
| I6.1.3 Availability of smart water meters | Proportion of the water consumers (including households, companies, etc) with ICT based water meters. |
| D6.2 Infrastructure/ connection to services - sewage | I6.2.1 Sewage system management using ICT | Proportion of the sewage system monitored using ICTNOTE – Monitoring includes both inspection and controlling. |
| I6.2.2 Drainage system management using ICT | Proportion of the drainage systems monitored in real-time using ICT.NOTE – Monitoring includes both inspection and controlling. |
| D6.3 Infrastructure/ connection to services – electricity | I6.3.1 Availability of smart electricity meters | Proportion of the electricity consumers (including households, companies, etc.) with ICT based electricity meters. |
| D6.8 Infrastructure/ connection to services – road infrastructure | I6.8.1 Availability of traffic monitoring using ICT | Proportion of streets with traffic monitoring using ICT (e.g., using sensors to produce traffic volume maps etc). |
| I6.8.2 Availability of parking guidance systems | Proportion of parking lots and street parking spaces with ICT based parking guidance systems. |
| I6.8.3 Availability of real-time traffic information | Proportion of public transport stops and stations with real-time traffic information available (via electronic bus bulletin boards, smartphone apps etc.)NOTE – Public transportation includes e.g., metro, bus, tram, train and ferry. |
| I6.8.4 Street lighting management using ICT | Proportion of street lamps under automatic management using ICT (e.g., light/sound control and solar power charging).NOTE – Management covers both inspection and regulation. |
| I6.8.5 Gas system management using ICT | Proportion of gas supply systems under automatic monitoring using ICT. |
| D6.11 Building | I6.11.1 Automatic energy management in buildings | Proportion of public and private sector buildings using ICT based systems to automatically regulate and reduce their energy needs.  |
| I6.11.2 Integrated management in public buildings | Proportion of public buildings using integrated ICT systems to automate building management and create flexible, effective, comfortable and secure environment.NOTE – ICT systems include building management, communication and control systems, etc. |

Appendix I

Additional indicators

The indicators listed in the following table are proposed as additional indicators for consideration. Cities can select appropriate ones among those, and/or add new indicators, in order to evaluate the contributions of ICT to their SSC goals.Each additional indicator is labeled (Ax.y.z), where (i) x denotes the dimension, (ii) y the sub-dimension and (iii) z the indicator.

|  |  |  |
| --- | --- | --- |
| Sub-dimension | Indicator | Description |
| D1.1 Networks and access | A1.1.1 Availability of mobile-cellular telephones | Mobile-cellular telephone subscriptions per 100 inhabitants (\*). |
| A1.1.2 International Internet bandwidth | International Internet bandwidth (bit/s) per Internet user (\*)NOTE – This is the sum of used capacity of all Internet exchanges offering international bandwidth. If capacity is asymmetric, then the incoming capacity is used. International Internet bandwidth (Mbit/s) per Internet user is calculated by converting to bits per second and dividing by the total number of Internet users. |
| A1.1.3 Use of Internet by city inhabitants | Proportion of inhabitants using internet. |
| A1.1.4 Coverage rate of digital broadcasting network | Proportion of digital broadcasting network covering families in the city. |
| A1.1.5 Availability of ultra high speed wireline connection | Proportion of households with access to downstream speeds equal to, or greater than, 30 Mbits/s. |
| A1.1.6 Availability of highspeed mobile broadband. | Proportion of city area which provides access to downstream speeds equal to, or greater than, 10 Mbits/s. |
| A1.1.7 Availability of WiFi in public areas | Number of WiFi hotspots at certain points in the city center. |
| A1.1.8 Availability of smart phones and tablets  | Number of smart phones and tablets per 100 inhabitants. |
| A1.1.9 Quality of fixed broadband | Mean-download speed (fixed) |
| A1.1.10 Quality of mobile broadband | Cell-edge performance (mobile) |
| D1.2 Services and information platforms | A1.2.1 Availability of electronic and mobile payment platforms | Existence of electronic and mobile payment platforms to facilitate access to city services for city inhabitants. |
| D3.9 Knowledge economy | A3.9.1 Intangible investments in comparison with total investments | Proportion of intangible investments (e.g., research and development, software, design, marketing, education and training) in new and existing businesses related to overall investments.NOTE – Such investments are related to the knowledge economy, and include investments in emerging high technology and in upgrading of traditional areas. |
| A3.9.2 Application of Geographic Information System (GIS) | Proportion of e-service companies with core business related to GIS serving the public, companies, government and other organizations. |
| A3.9.3 Application of big data | Proportion of e-service companies with core business related to big data storage and analysis serving the public, companies, government and other organizations. |
| D4.1 Education | A4.1.1 Application of e-learning in schools | Proportion of pupils in primary and secondary schools having access to e‑learning systems. |
| A4.1.2 Application of e-learning in academic studies | Proportion of students aiming at an academic degree performing their education mainly through e-learning systems. |
| D5.3 Openness and public participation | A5.3.1 Availability of cultural resources online | Proportion of cultural institutions and events in the city for which online participation is offered. NOTE – The indicator measures how ICT increases the availability of cultural resources, such as museums, galleries etc, to a broader audience. |
| D5.4 Governance | A5.4.1 Existence of strategy, rules and regulations to enable the use of public data | Existence of a framework to enable the use of public data of cities. |
| D6.1 Infrastructure/ connection to services – piped water | A6.1.1 Availability of visualised real-time information regarding water use  | Proportion of users with real-time information on quantum of water usage and water use pattern. |
| D6.3 Infrastructure/ connection to services – electricity | A6.3.1 Electricity supply system management using ICT | Proportion of power substation and user points under automatic inspection using ICT.NOTE – Management of electricity supply is an important ICT task, but data may not be available to cities. |
| A6.3.2 Availability of visualised real-time information regarding electricity use | Proportion of users with real-time information on quantum of electricity usage and electricity use pattern. |
| D6.8 Infrastructure/ connection to services – road infrastructure | A6.8.1 Availability of visualised real-time information regarding gas use | Proportion of users with real-time information on quantum of gas usage and gas use pattern. |
| A6.8.2 Availability of online bike/car sharing system | Proportion of city area covered by an online bike/car sharing system  |
| NOTE – Indicators marked by (\*) are based on ITU ICT Development index (<https://www.itu.int/ITU-D/ict/publications/idi/index.html>) |

Appendix II

UN habitat City Prosperity Index

**In the Wheel of Prosperity as defined by UN Habitat, the "spokes"** are the five dimensions of prosperity: Productivity, Infrastructure development, Quality of life, Equity and social inclusion, and Environmental sustainability.



In the City Prosperity Index each dimension has its own index and it might be built up by a number of indices. The basic City Prosperity Index as reported in a publication consists of the following sub‑indices and indicators:

|  |  |
| --- | --- |
| Dimension | Definition/variables |
| Productivity | The productivity index is measured through the city product, which is composed of the variables: capital investment, formal/informal employment, inflation, trade, savings, export/import, and household income/consumption. The city product represents the total output of goods and services (value added) produced by a city´s population during a specific year. |
| Quality of life | The quality of life index is a combination of four sub-indices: education, health, safety/security and public space. The sub-index education includes literacy, primary, secondary and tertiary enrolment. The sub-index health includes life expectancy, under-five mortality rates, HIV/AIDS, morbidity and nutrition variables. |
| Infrastructure development | The infrastructure development index combines two sub-indices: one for infrastructure and another for housing. The infrastructure sub-index includes: connection to services (piped water, sewage, electricity and ICT), waste management, knowledge infrastructure, health infrastructure, transport and road infrastructure. The housing sub-index includes building materials and living space. |
| Environmental sustainability | The environmental sustainability index is made of four sub-indices: air quality (PM10), CO2 emissions, energy and indoor pollution. |
| Equity and social inclusion | The equity and social inclusion index combines statistical measures of inequity of income/consumption (Gini coefficient) and social and gender inequity of access to services and infrastructure. |

Reference: UN Habitat report "State of the World's cities 2012/2013 Prosperity of Cities", Table 1.1.3, p 18.

There is also an extended City Prosperity Index with more indicators and a plan to include Governance as a sixth dimension. Furthermore, specific work has been done on Streets as a driver for prosperity.

UN Habitat (2013), *State of the World's Cities 2012/2013, Prosperity of Cities*: <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3387>

UN Habitat (2013), *Streets as Public Spaces and Drivers of Urban Prosperity*: <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3513>

Bibliography

[b-FG-SSC KPIs metrics] FG-SSC deliverable, *Technical Report on metrics and evaluation of key performance indicators for smart sustainable cities*

[b-FG-SSC overview] FG-SSC deliverable (2014), *Technical Report on* *an overview of smart sustainable cities and the role of information and communication technologies*.

[b-FG-SSC infrastructure] FG-SSC deliverable, *Technical Report on overview of smart sustainable cities infrastructure*

[b-FG-SSC security] FG-SSC deliverable, *Technical Report on cyber-security, data protection and cyber-resilience in smart sustainable Cities*.

[b-FG-SSC building] FG-SSC deliverable, *Technical Report on smart buildings for smart sustainable cities*.

[b-FG-SSC water] FG-SSC deliverable (2014), *Technical Report on* s*mart water management in cities*.

[b-FG-SSC management] FG-SSC deliverable, *Technical Report on* *integrated management for smart sustainable cities*.

[b-FG-SSC stakeholders] FG-SSC deliverable, *Technical Report on engaging stakeholders for smart sustainable cities*.

[b-ISO TDS 37151.1] ISO TDS 37151.1:2014, *Smart community infrastructures – Principles and requirements for performance metrics*.

\_\_\_\_\_\_\_\_\_\_\_\_

1. The terms of reference of FG-SSC particularly mention environmental sustainability. However, this document tries to have a broader perspective and embraces also indicators that are related to quality of life, social and economic aspects. [↑](#footnote-ref-1)
2. Note that this list only contains the sub-categories for which indicators are defined in this document. For a total set of sub-categories refer to [ITU-T L.KPIs-overview]. [↑](#footnote-ref-2)
3. ICT devices are regulated nationally and are not included. [↑](#footnote-ref-3)
4. In general equity and inclusion in relation to ICT are difficult to measure by defining specific indicators. Therefore, in addition to the indicators defined in dimension D5, cities are encouraged to disaggregate and analyse their data with respect to aspects such as gender, age, income, specific needs and geographic location/area. [↑](#footnote-ref-4)