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SERIES L: ENVIRONMENT AND ICTS, CLIMATE
CHANGE, E-WASTE, ENERGY EFFICIENCY;
CONSTRUCTION, INSTALLATION AND PROTECTION
OF CABLES AND OTHER ELEMENTS OF OUTSIDE
PLANT

Circular and sustainable cities and communities

City science application framework

Recommendation ITU-T L.1610

ITU-T L-SERIES RECOMMENDATIONS

ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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Recommendation ITU-T L.1610

City science application framework

Summary

Recommendation ITU-T L.1610 proposes to analyse and solve urban problems and challenges by using the city science method. It demonstrates that by using empirical evidence such as data, the city science method provides the most reliable and consistent way for cities to tackle urban challenges.

As urbanization continues to accelerate, urban governance is struggling to adapt to environmental and sustainability challenges. The high degree of urban sprawl demands urban planning to be reinvented in order to improve land and resource allocations. This creates further tension between urban and suburban areas (locations of close proximity to cities) in terms of economic and environmental sustainability.

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Introduction

Urbanization is progressing at an unprecedented rate with 68% of the world population expected to reside in urban areas by 2050 [b-UN]. 90% Of the increase in world population is expected to take place in Asia and Africa, putting tremendous pressure on these regions to cope with the new human development challenges associated with this influx of population. It is important to acknowledge that while urban migration brings new economic opportunities and makes social services and cultural activities more accessible to many, it is equally important to address the rising challenges that urban governance has to address, including economic inclusiveness, increased resource consumption, environmental deterioration, surging housing needs and new physical infrastructure.

This high degree of urban sprawl demands urban planning to be reinvented in order to improve land and resource allocations. This creates further tension between urban and suburban areas (locations of close proximity to cities) in terms of economic and environmental sustainability. Mobility is becoming one of the most significant concerns for city inhabitants all over the world as the associated economic and health costs are ever rising. The lack of affordable housing with basic necessities, such as, water, energy, sanitation and waste disposal, causes informal settlements that often fail to comply with basic planning and regulations to flourish. The pressure on food, water and energy resources is also steadily mounting.

Urban sprawl also adversely impacts urban environment by diminishing green spaces, intensifying air pollution and increasing waste generation. Furthermore, cities are dense and highly congested places that are prone to the devastating consequences of climate change. More than 80% of cities in 2014 were located in areas that are vulnerable to economic losses associated with natural disasters and other environmental catastrophes [b-IPCC]. Sea level rise, floods, storms, urban heat wave, earthquakes, etc. are all potential resilience challenges that urban areas have to confront.

In this context, this Recommendation uses a scientific method, the city science method, to analyse and solve these urban problems and challenges. It demonstrates that by using empirical evidence such as data, the city science method provides the most reliable and consistent way for cities to tackle urban challenges.

Recommendation ITU-T L.1610

City science application framework

1 Scope

This Recommendation provides a framework for using scientific techniques and data-driven methods to solve urban challenges including environment and sustainability. This framework consists of a four-step methodology that enables city stakeholders to use empirical evidence to assess, prioritize and boost their city applications. This framework first defines the core components of the city science application framework, including data, scientific techniques, the role of city science stakeholders and city science enablers. It then details the four-step methodology for implementing science solutions and assessing their projected impacts, including:

- 1) assessment of the current city science applications status (baselining);
- 2) identification of the prioritized areas to apply city science;
- 3) boosting city science applications using enablers;
- 4) assessment of projected city science applications impact.

The city science application framework provides a practical approach to solve urban challenges and is expected to support city stakeholders to achieve the Sustainable Development Goals.

This Recommendation is based on [b-U4SSC F].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AI	Artificial Intelligence
ICT	Information and Communication Technology
IoT	Internet of Things
NGO	Non-Governmental Organization
PESTEL	Political, Economic, Social, Technological, Environmental and Legal

PPP	Public–Private Partnership
R&D	Research and Development

5 Conventions

None.

6 City science

City science is the use of scientific methods and techniques to solve urban problems and challenges. The scope of problems addressed by city science encompasses a wide range of sectors. In this Recommendation, city science:

- aims to address and solve urban challenges and problems;
- uses data extensively;
- applies scientific techniques and methods by using science, technology and innovation.

The following simple steps describe the city science approach, formulated in this Recommendation, to solve a given urban problem.

- Identification – entails understanding the urban problem.
- Modelling – includes transformation of the identified urban problem into a model that represents it.
- Model solution – entails derivation of a solution to the initially identified urban problem.
- Model application – includes the actual implementation of a city science solution in the context of a real city by applying the model solution to the urban problem. It may also entail applying a set of enablers to accelerate and increase the likelihood of success.

Clause 9 introduces a city science application methodology that incorporates these steps among others into the overall framework.

6.1 Urban challenges and problems

The following is a list of potential urban problems sorted into different categories as identified in this Recommendation:

- a) environment (air, water, energy, land, waste, biodiversity, green spaces, etc.);
- b) mobility (transportation, movement, traffic, etc.);
- c) economy (financial sectors and industries, etc.);
- d) society (people, education, health, etc.);
- e) governance;
- f) safety and security;
- g) resilience.

Urban problems in these categories create enormous opportunities for the application of city science.

6.2 Data

Cities today have a large number of data sources. Digital transformation and information and communication technology (ICT) initiatives in the landscape of emerging technologies have proliferated data creation and consumption in cities. Edge devices, Internet of things (IoT), city information systems, legacy systems, etc., generate a huge amount of data. In this context, data acts as a strategic asset for cities through which they can generate new insights, create new services and resolve various urban challenges.

City science utilizes city data as input or raw material to solve urban challenges. The potential of data is enormous when transformed into beneficial insight and action by the city.

6.3 Scientific techniques and methods

City science uses scientific techniques and other data driven methods to solve urban challenges. The dynamic and complex nature of cities allows mathematical models and techniques to be applied; i.e., urban problems can be modelled and recast as scientific models and problems.

The complex behaviours and relationships within and between different city constituents form various flows and networks. Modelling such phenomena is conducive to application of sophisticated analysis and problem-solving techniques such as optimization, stochastic and deterministic models, simulation, bottom-up evolutionary models, graphs and networks and mathematical programming techniques (linear and dynamic).

7 City science stakeholders

Components of the circular city implementation framework

There is a broad range of stakeholders for city science. Urban problems and their solutions exist in a rich ecosystem composed of many organizations that contribute directly or indirectly. The consumers, providers and beneficiaries of city science solutions encompass a multitude of entities or organizations in general.

The ecosystem for solving urban problems through the application of city science includes the stakeholders listed in Table 1, among potential others.

Table 1 – Existing definitions of circular economy

City science stakeholder type	Stakeholder brief description and relationship to city science
Public sector	The public sector is the part of an economy in which goods and services are produced and/or (re)distributed by government [b-US Legal 2]. Hence, it includes public services and public enterprises. Public services include public goods and governmental services such as the public infrastructure (public roads, bridges, tunnels, water supply, sewers, electrical grids, telecommunications, etc.), public transit, public education, along with health care, military, police. Public enterprises, or state-owned enterprises, are self-financing commercial enterprises that are under public ownership which provide various private goods and services for sale and usually operate on a commercial basis [b-QHSE]. Public sector organizations can utilize city science in enhancing public services and increasing their effectiveness and efficiencies (e.g., public services planning, energy and water efficiency, transportation routes optimization, traffic flow enhancement and air quality enhancement).
Private sector	The private sector is the part of an economy in which goods and services are produced and distributed by individuals and organizations that are not part of the government or state bureaucracy [b-US Legal 1]. The private sector is run by private individuals or groups, usually as a means of enterprise for profit, and is not controlled by the state. Private sector can take a producer (supplier) role of city science solutions and services. Urban problems form a viable and potential commercialization opportunity for the private sector.
City manager (administrator)	A city manager is an official appointed as the administrative manager of a city, in a council-manager form of city government. Local officials serving