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Smart community infrastructures — Urban data integration framework for smart city planning (SCP)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents **should** be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*, Subcommittee SC 1, *Smart community infrastructures*.

Introduction

The city is a product of social evolution, technology, economic and social civilization improvements, as well as a fundamental unit for the social and economic life of its region. However, with the influence of global urbanization, increasingly more problems have been observed, such as environmental pollution, traffic congestion, insufficient resources, urban lifeline system weakness, etc.

Human is the main participant of urban social & economic activities, and they serve the nature with their own civilization and wisdom. Human beings make material production and living standard increasingly rising, while nature and geography restrain and control human activities.

Urban ecosystems are taking shape. Urban planning is the development vision of urban ecosystem construction and can promote the sustainable development of urban ecosystems.

Urban Planning refers to the conduct of engineering construction, economy, society, environment and land use of the city and its surroundings. It involves the regional layout of industry, the regional layout of buildings, the setting of transportation infrastructure and the planning of urban engineering. It is related to urban development and city infrastructure construction.

The planning, construction, operation, management, evaluation of community infrastructure is the process of natural environment transformation. This process involves multiple city managers and various data. Therefore, the integration of heterogeneous data for smart community infrastructure planning is particularly important. Based on ecological and spatial information, the SCP data and infrastructure data that need to be integrated **should** be analysed. The establishment of a data integration framework and further realization of heterogeneous data integration is to support the operation of community infrastructure construction projects throughout the life cycle, and ultimately achieve inclusive, sustainable and high-quality development of the city.

In addition, this document also relates to the following standards:

ISO 37120:2018 Sustainable cities and communities — Indicators for city services and quality of life

ISO 37122:2019 Sustainable cities and communities — Indicators for smart cities

ISO 37123:2019 Sustainable cities and communities — Indicators for resilient cities

ISO/TS 37151:2015 Smart community infrastructures — Principles and requirements for performance metrics

ISO/TR 37152:2016 Smart community infrastructures—Common framework for development and operation

ISO 37156:2020 Smart community infrastructures — Guidelines on data exchange and sharing for smart community infrastructures

PAS 183:2017 Smart cities – Guide to establishing a decision-making framework for sharing data and information services

In terms of smart community infrastructure, ISO/TS 37151 describes the principles and requirements of performance metrics. ISO/TR 37152 gives possible issues and solutions in developing and operating smart community infrastructure, outline and benefits of a common framework for development and operation. In addition, PAS183 provides data interoperability, types of data, data protection reform, data value chain, purposes for data use, assessing data states, access rights for data and data structure.

The three standards above provide the basis and guidance for ISO 37156. ISO 37156 describes the types and model, opportunities, privacy and security of data exchange and sharing, and provides guidance for data exchange and sharing of smart community infrastructure. ISO 37156 provides guidance for the integration of infrastructure data in this document, and this document is considered to be an application scenery of ISO 37156 in data integration.

ISO/IEC JTC1/WG11 and IEC/SyC Smart Cities are also researching smart city series standards. The relation between this document and the standards of these two organizations will be considered.

Smart community infrastructures — Urban data integration framework for smart city planning (SCP)

1 Scope

This specification focuses on the integration and application of heterogeneous data from urban infrastructure systems, e.g. water, transport, energy, drainage and waste, etc., so as to support smart city planning.

It builds a data framework that involves possible multi-source common data through standardized data integration and sharing mechanism, which include recommendations for:

— precision, dimension of the data, where at the same time raise the recommendations on data collection, update, and storing mechanism;

— a data model for data integration, make suggestions on data standardization and data fusion approaches for heterogeneous smart city infrastructure data for each involved data;

— a data security level and sharable attributes for each involved data, establishes principles on data sharing/exchange.

2 Normative references

There is no normative reference in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
data
reinterpretable representation of information in a formalized manner suitable for communication, interpretation or processing Note 1 to entry: Data can be processed by humans or by automatic means.

[SOURCE: ISO/IEC 2382:2015, 2121272]

3.2
data availability
data of being accessible and usable upon demand by an authorized entity

[SOURCE: ISO/IEC 27000:2018, 3.7, modified – the word 'property' has been modified as 'data']

3.3
data exchange
accessing, transferring, and archiving of data

[SOURCE: ISO/TS 13399-5:2014, 3.7]

3.4
data sharing
reference for providing shared, exchangeable and extensible data to enable urban infrastructure service

[SOURCE: ISO 37156, 3.3.6]

3.5
data type
defined set of data objects of a specified data structure and a set of permissible operations, such that these data objects act as operands in the execution of any one of these operations

[SOURCE: ISO/IEC 20546:2019, 3.1.12]

3.6
heterogeneous data integration
optimization method to enable effective and transformative use of data and technology from multi-source to support sustainable development of cities and to improve the management and control of space and resources

3.7
information
data in context with a particular meaning

[SOURCE: ISO 5127:2017, 3.116]

3.8
information resource
asset, record
<set of data>, document, or item in physical or digital form that contributes to human knowledge

Note 1 to entry: An abstracting and indexing database is an example of an information resource.

Note 2 to entry: Information resources sometimes have broader meanings not only including information contents but also including technology resources, human resources, financial resources that enable information contents management.

[SOURCE: ISO 5127:2017, 3.1.1.44; modified – Note 2 to entry has been added.]

3.9
life cycle
<of a system, product, service, project or other human-made entity> evolution from conception through to destruction or recycling

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.23, modified — “through retirement” has been replaced by “through to destruction or recycling”.]

3.10
security
condition that results from the establishment and maintenance of protective measures that ensure a state of inviolability from hostile acts or influences

[SOURCE: IEC Guide 120:2018, 3.13]

3.11
smart community infrastructure
community infrastructure with enhanced technological performance that is designed, operated and maintained to contributed to sustainable development and resilience of the community

[SOURCE: ISO 37156:2019, 3.1.4]

3.12
smart city planning
SCP
technical and political process concerned with the development and design of land use and the built environment, which are enhanced by the effective and sustainable integration of informational, physical, and social systems and the transformative use of heterogeneous data and technology

3.13
system
set of interrelated or interacting functions constituted to achieve a specified objective

4 Principles

4.1 General

The data gathered and to be integrated for SCP should meet some general principles so as to ensure the validity of the following data integration process.

4.1.1 Data availability

The data to be integrated for SCP comes from various sources, some of which are private and classified prior to any data sharing agreements. Thus, the description of shared data in terms of attributes, dimensions, and volumes, etc., should be available to associated integration subjects (described in 6.2), so as to determine whether the shared data are truly available for the intended data integration purpose.

4.1.2 Sovereignty over the data

The ownership of the source data needs to be respected during the whole data integration process among associated stakeholders.

4.1.3 Data security

The data to be integrated for SCP should be secured during the data integration process, from data retrieval, data clean, data storage, and data output.

Regional and national security requirements such as the EU General Data Protection Regulation are considered. Based on ISO/IEC 27000, considering domestic regulations and technological conditions, an information security management systems (ISMS) or alternative necessary data security procedure and tools should be introduced from possible hacker attacks and other misapplication.

The data exchange should therefore be kept to a minimum and a low level of details. Security relevant data for planning, constructing, operating and managing of infrastructures should basically remain with the data collecting organization, ordinarily the utilities.

4.1.4 Data privacy

The data from community infrastructure to be integrated for SCP usually contains private information, from individual socio-economic characteristics to spatial-temporal behavioural data. Integrating and further analysing these individual-based data help to evaluate and optimize urban system performances. But individual privacy should be respected.

The use of source data during the whole integration process should be kept on an anonymous basis. The integration of individual data, for example, consumer consumption data, should be pre-desensitized without personal information exposed to neither data integration engineers nor terminal users.

4.1.5 Co-construction and sharing

It is possible that an intended data integration requires data from different agencies/stakeholders. It is advantageous if the necessary data are co-constructed and shared among them on a voluntary basis. In addition, the integration results are also encouraged to share with contributors.

4.2 Principles of heterogeneous data integration

4.2.1 General

In practice, the multi-source data used for data integration varies in format, dimensions, accuracy, and durability. Although data integration approaches are evolving with more recognition/explanation power, it is not usually encouraged to spend huge cost on retrieving missing data. Depend on the availability and intended use of data, it is advantageous if the data integration framework applies the following principles of heterogeneous data integration.

4.2.2 Unambiguity

The definitions and categorizations of entities **should** be clear where reasonably possible and available, unambitious. It is advantageous if categorization **should** be representative and mutually exclusive.

4.2.3 Scalability

Urban data integration requirements and process are continuously updating. The integrated data need not be thoroughly completed and comprehensive in the beginning, but it is advantageous if the integration results are flexible and scalable.

4.2.4 Compatibility

Data standards applied in the data integration framework need to be compatible with existing major urban data standards.

4.2.5 Modularity

It is advantageous if data integration input, output, and approaches/algorithms are defined as modular components, so as to be used individually or in combination for different integration purposes.

In addition to unambiguity, scalability, compatibility and modularity, the urban data integration framework **should** also have extensibility and interpretability. Maintaining a high-level of interpretability is vital during the integration process as the goal is to support the urban design and operational decisions by municipal officials, policymakers and engineers technical staff. A useful urban data integration framework **should** be capable of integrating heterogeneous data in an extensible (to multiple urban systems), scalable (to the growing amounts of quickly changing urban data streams) and interpretable manner (such that it can inform decision-making).

4.3 Data quality recommendations

On the base of ISO 19157, the following recommendations are depending on the intended use of the data. For example, zonal plans may be acceptable with a tolerance of several metres, but plans for individual buildings may require an absolute positional accuracy of a few centimetres. The quality recommendation of a variety of planning data database results **should** ensure locational accuracy, attribute accuracy, completeness, logical consistency, geographic quality, and data relationality as far as the data are available and it is even possible to determine such data.

a) Locational accuracy. It is advantageous if the location given in the data **should** match the location in the real world to the extent required by the expected use.