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

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National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 of 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 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*.

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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 and urban lifeline system weakness.

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 and 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 smart city planning (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 intended to support the operation of community infrastructure construction projects throughout their life cycles and ultimately achieve inclusive, sustainable and high-quality development of the city.

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, BS/PAS 183 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.

ISO/TS 37151, ISO/TR 37152 and BS/PAS 183 provide the basis and guidance for ISO 37156, which 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.

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

1 Scope

This document establishes a data framework that involves possible multi-source common data through standardized data integration and sharing mechanisms. It includes recommendations for:

— precision, dimensions of the data, data collection, updates and storing mechanisms;

— a data model for data integration, data standardization and data fusion approaches for heterogeneous smart city infrastructure data;

— a data security level and sharable attributes for all involved data, principles on data sharing or exchange.

This document focuses on the integration and application of heterogeneous data from urban infrastructure systems, such as water, transport, energy, drainage and waste, so as to support smart city planning (SCP). It contains case studies, in Annex A, of various smart city projects.

2 Normative references

There are no normative references 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:

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

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

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
property of being accessible and usable upon demand by an authorized entity

[SOURCE: ISO/IEC 27000:2018, 3.7, modified — term revised.]

3.3
data exchange
accessing, transferring, and archiving of *data* (3.1)

[SOURCE: ISO/TS 13399-5:2014, 3.7, modified — definition revised.]

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3.4
data sharing
reference for providing shared, exchangeable and extensible *data* (3.1) to enable urban infrastructure service

[SOURCE: ISO 37156:2020, 3.3.6, modified — definition revised.]

3.5
data type
defined set of *data* (3.1) objects of a specified data structure and a set of permissible operations, such that these *data* (3.1) objects act as operands in the execution of any one of these operations

[SOURCE: ISO/IEC 20546:2019, 3.1.12, modified — Notes to entry removed.]

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 (3.1) in context with a particular meaning

[SOURCE: ISO5127:2017, 3.1.1.16, modified — definition revised.]

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

EXAMPLE Abstracting and indexing database.

Note 1 to entry: Information resource sometimes has a broader meaning, including information content, and also technology resources, human resources and financial resources that enable information content management.

[SOURCE: ISO 5127:2017, 3.1.1.44; modified — definition revised and Note 2 to entry 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 — definition revised.]

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 37156:2020, 3.1.4]

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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

4.1.1 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.

4.1.2 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, for example, attributes, dimensions and volumes 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.

4.1.3 Sovereignty over the data

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

4.1.4 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 shall be 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 to deter possible hacker attacks and other misapplication.

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

4.1.5 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 being exposed to either data integration engineers or terminal users.

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4.1.6 Co-construction and sharing

It is possible that an intended data integration requires data from different agencies or stakeholders. It is recommended that the necessary data are co-constructed and shared among them on a voluntary basis. In addition, the integration results should be shared 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 or explanation power, it is not usually encouraged to spend huge amounts on retrieving missing data. Depending on the availability and intended use of data, it is recommended that 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. 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 recommended that the integration results are flexible and scalable.

4.2.4 Compatibility

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

4.2.5 Modularity

It is recommended that data integration input, output and approaches or 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 engineer 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 basis of ISO 19157, the following recommendations are dependent on the intended use of data. For example, zonal plans can be acceptable with a tolerance of several metres but plans for individual buildings might 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 recommended that the location given in the data satisfies data requirement in terms of geographic accuracy.

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