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Smart community infrastructures — Data framework for infrastructure governance based on digital technology in smart cities

Infrastructures urbaines intelligentes — Cadre de données pour la gouvernance des infrastructures fondée sur la technologie numérique dans les villes intelligentes

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

With more than half of the world's population living in cities, the city is the place where resources and economic and social activities are concentrated. As a space carrier for human beings in economic, social, cultural, and political activities, the city has become a source of technological innovation, an engine of economic growth, a platform for cultural development, a centre for decision-making, and a node for external connections. In the context of globalization, the city has become increasingly important. However, poor management of the city causes states of confusion and disorder, e.g. traffic congestion, environmental pollution, shortage and waste of resources, which is incompatible with sustainable development and the UN Millennium Development Goals.

City infrastructures are the foundation of city operations and the goal of city management, including municipal infrastructures, information and communications technology (ICT) infrastructures (see ISO/TR 37150). Information and digital technologies, e.g. mobile Internet, Internet of Things, and systems integration, provide a fundamental basis for infrastructure management. Based on digital technologies and systems, the digital city management framework can be expanded by integrating information, ICT and public facilities and services. Meanwhile, the city management database can be constructed by adopting various data bases from existing city data sources, e.g. environmental monitoring, traffic monitoring, energy supply, and demographic statistics. The collection and integration of various factors of city management will improve the data standardization and promote collaboration across departments and businesses. This can improve the service capabilities of city infrastructures and contribute to improving processes and services that facilitate and support liveability within the city. The specific practices of infrastructure governance will depend on the characteristics and actual demands of the city and considering protection of data privacy, public participation, the sovereignty of data.

This document provides a unified data framework of city infrastructure governance, underpinned by management and applications, security and privacy principles. This document is a reference for stakeholders and provides a data framework and system structures, which help city governments, enterprises, organizations and individuals participate in city activities and infrastructure governance.

NOTE Annex A outlines useful case studies of data framework for digital governance of infrastructure in smart cities.

Smart community infrastructures — Data framework for infrastructure governance based on digital technology in smart cities

1 Scope

This document provides a framework for the application of digital technologies in smart community infrastructures to improve the capacity of digital governance of infrastructure.

This framework is applicable to infrastructure governance in smart cities and is intended to be a basic data framework for infrastructure governance. It can establish the basis for future standardization of smart city infrastructures and can be further applied in other aspects of city management.

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 terminology 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 framework
structure of processes and specifications designed to support the collection, transmission, organization and use of data to applied services

3.2
digital governance of infrastructure
activity that is coordinated and implemented by a set of activities aimed to design, implement and monitor a strategic plan for city infrastructure and its data management through, e.g. the Internet of Things (IoT), cloud computing, mobile Internet, geospatial information, big data and other new-generation information technologies, to realize efficient management of city infrastructure

Note 1 to entry: Governance of data is described in ISO/IEC 38505-1.

Note 2 to entry: Digital governance includes (but is not limited to) digital strategy, digital policies, digital standards, digital processes, digital procedures, digital roles and digital control tools, put in place to meet regulatory, legal, risk and operational requirements.

3.3
component
part of a system delimited according to structural or functional aspects, which can still implement independent sub-functions

EXAMPLE Municipal engineering facilities, transportation facilities, amenity and environment facilities, landscaping facilities and other facilities are component of city infrastructure.

[SOURCE: ISO 20890-4:2020, 3.10, modified — The EXAMPLE has been added.]

3.4
event
occurrence, which may have an effect on the outcome of a measurement or inspection operation and which should be recorded

Note 1 to entry: Phenomena and behaviour caused by human or natural factors need to be dealt with by an urban management department and restored to normal, such as *components* (3.3), urban appearance, environment and environmental order, to be affected or destroyed.

[SOURCE: ISO 23952:2020, 3.4.57, modified — Note 1 to entry has been added.]

3.5
city unit grid
division of jurisdictional areas based on a city scale, administrative divisions and population distribution

Note 1 to entry: City unit grid can provide basic geographical data as digital control tools for digital governance.

4 General

The data framework for digital governance of infrastructure in a smart city is made up of three parts: application, platform and database, as illustrated in Figure 1.

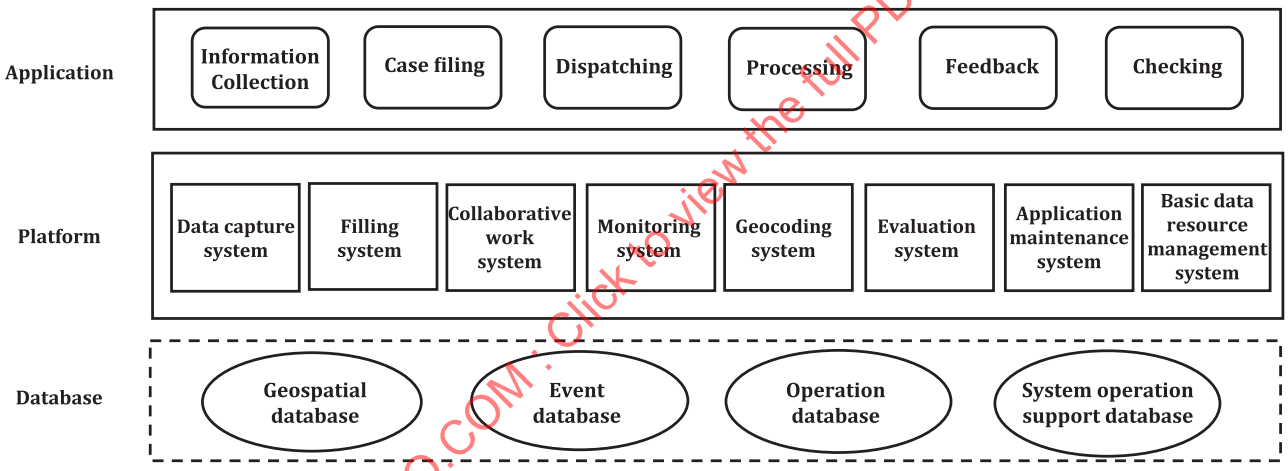

Figure 1 — Scheme of data framework for digital governance of infrastructure in a smart city

As shown in Figure 1, to meet the needs of digital city management, the data framework contains the following parts to ensure effective operation:

a) To support the data platform, databases (including geospatial databases, event databases, operation databases and system operation support databases) are introduced. The details are described in Clause 5.

b) To enable the digital processing of the application, the data platform is introduced and formed by different systems to provide close-loop information management for comprehensive municipal cases. The details are described in Clause 6.

c) As the application of the data framework, the main process of digital governance of infrastructure in a smart city can be achieved in six steps: information collection, case filing, dispatching, processing, feedback and checking. The details are described in Clause 7.

5 Database

5.1 Geospatial data

5.1.1 General

The geospatial database includes geospatial framework data and unit grid data and can cover the following scope in general: administrative boundaries, geocoded addressing. positioning, place names, land parcel and property, imagery, transport, water, elevation and depth, land cover and land use, as well as statistical information.

5.1.2 Geospatial framework data

5.1.2.1 Classification of framework data

City geospatial framework data should cover the fields of administrative division, transportation, field of water, construction, underground space and components. The framework data should be classified by certain rules and should support multi-level classification and user-defined classification rules.

5.1.2.2 Description and expression of framework data

City geospatial framework data should describe the spatial features and attributes of city geospatial elements and include the temporal characteristics of data collection or updating. Spatial features of framework data should be described in point, line and plane features.

The attribute features of framework data should be composed of basic attributes and extended attributes. Basic data should include a data element category code, unique identification code, data element name, data capture date, and data source. Extended data should be able to be defined based on individual characteristics of data elements.

5.1.2.3 Coding of framework data element

The unique identification code of city geospatial framework data elements should be coded by certain rules.

5.1.3 City unit grid data

5.1.3.1 City unit grid data attributes

The attribute information of city unit grid data should include a unique identification code, name, area, vertex coordinates of a grid, and data capture date.

5.1.3.2 Coding of city unit grid data

The unique identification code of city unit grid data should be coded by following certain rules, including the administrative division code and grid sequence code.

5.1.3.3 Association of city unit grid data

City unit grid data should be associated with relevant data such as geospatial framework data, event data and grid administrator data.

5.2 Event data

5.2.1 Event classification

The event should be classified by certain rules, covering components, urban appearance, environment and environmental order, with multi-level classification and custom configuration supported.

5.2.2 Event data coding

The event should have a unique serial number, which should be coded by following certain rules, such as the administrative division code, the classification, time-stamp and sequence code of the event.

5.2.3 Event data attributes

The event attributes should be composed of basic attributes and extended attributes. The basic attribute includes the serial number, name, classification, administrative division, unit grid, occurrence time and data source of the event. The extended attribute can be defined according to the individual characteristics of the event. Table 1 shows an example of the details of event data attributes.

Table 1 — Event attribute data content, structure, and field code

Order number	Property item name	Field code	Field type	Length of field	Definition and the range of the value domain	Constraints / conditions
1	event code	ObjCode	char	10	event classification code	M
2	event name	ObjName	char	30	the standard name of the event	M
3	administrative division code	DeptCode1	char	10	code of the administrative division of the event	M
4	administrative division name	DeptName1	char	60	the full name of the administrative division of the event	M
5	location of the event	ObjPosition	char	100	description of the location of where the event occurred	M
6	unit grid	BG ID	char	15	unit grid identifier of the event	M
Key M: mandatory						

5.3 Operation data

5.3.1 Overview

Operation data should include the event handling process data, evaluation data of event handling results, processing result evaluation data and public opinion event analysis data.

5.3.2 Event handling process data

Event handling process data should include the event serial number, handler, handling time, status, and opinions, as well as related videos, pictures, files and other information uploaded during the event processing.

5.3.3 Evaluation data of event handling results

The evaluation data of event handling results should include the event serial number, evaluation results, evaluator and evaluation time.

5.4 System operation supporting data

5.4.1 Overview

The system operation supporting data can include user authentication data, regional data, organizational data, workflow data, grid administrator data, map-related data and data dictionary item data.

5.4.2 User authentication configuration data

User authentication configuration data should include the information of the user group, user, role, permission data, authorization role association, user role association and user group role association.

5.4.3 Regional configuration data

Regional configuration data should include the information of the administrative regions at all levels of the city, including region name, code, type and superior region code.

5.4.4 Organization configuration data

Organization configuration data should include the information of the competent organizations of the city, including organization name, code, type and the code of the region.

5.4.5 Workflow configuration data

Workflow configuration data should include the configuration information of process type, node and node processing object.

5.4.6 Grid administrator configuration data

Grid administrator configuration data should include grid code, name, certificate type, ID number, organization unit code and other information about the grid administrator.

5.4.7 Map-related configuration data

Map-related configuration data should include the information configuration of the physical layer, logical layer, thematic layer, map elements, code definition, map default centre point, map default zoom level and map default display mode.

5.4.8 Configuration data of data dictionary item

Configuration data of data dictionary items should include the information configuration of component type, component status, event type, event level, event status, data source, administrative region type, coordinate system type and certificate type.

5.5 Metadata

While collecting, processing and updating all kinds of data, corresponding metadata should be established according to the data set, including management ownership metadata, management object metadata, hierarchical classification metadata, additional attribute metadata.

Metadata should describe the content, quality and status of data, and provide support for data management, maintenance, retrieval and application by different regions.

The meta database should include all metadata corresponding to the geospatial database, event database, service database and system operation support database. The metadata database should be expected to establish a corresponding relationship with the database described.

5.6 Data updating

A data index should be established after adding data to the storage. After the data is stored, the data should be checked and tested, including normalization, integrity and logical consistency of the data, and the test specifications and test documents of the database should be established.

In addition, a comprehensive database can be established, including urban management basic database, urban event monitoring, urban management industry application, public appeal, public opinion monitoring and other data, and the content of data construction can be expanded according to actual needs.

An update mechanism should be established for all types of data and their metadata; the update frequency should be specified according to the specific data type. The quality of the updated data should not be lower than that of the original data. All types of updated data should be inspected and accepted. The corresponding database should also be updated after the data update.

6 Data platform and system

6.1 Data capture system

The data capture system should be able to collect information such as event types, identification codes, location coordinates and problem description details. The data form should include, e.g. text, image, voice, and videos. The system should support data compression and reporting, as well as batching the reporting of multiple data.

6.2 Filing system

The filing system verifies the data collected by the data capture system. It can also accept events reported by the public, and can provide additional information, such as event details and geospatial information.

6.3 Collaborative work system

The collaborative work system links data collection, filing, dispatching, processing, feedback and checking, and achieves information synchronization and collaborative work across professional departments.

6.4 Monitoring system

The monitoring system displays real-time information, which can integrate geospatial data and operation data. The system also provides real-time monitoring service on the location, disposal process, on-duty situation of administrators, processing results, comprehensive evaluation and other information on municipal problems.

6.5 Geocoding system

The geocoding system provides a spatial position of event and geocoding services, such as address description, address query and address matching.

6.6 Evaluation system

The evaluation system provides quantitative evaluation for various aspects of city management, such as municipal regions, relevant government departments and positions. The evaluation should consider indicators relating to data collection, filing, dispatching, processing, feedback and checking.

6.7 Application maintenance system

The application maintenance system should consider the management organization, authorization and workflows, to achieve the management, maintenance and expansion of the system. It should have multi-level workflow configuration functions.

6.8 Basic data resource management system

The basic data resource management system contains all kinds of spatial data. It is required to support other systems and should be able to store and update geospatial data.

7 Governance and applications

Independent digital governance of the infrastructure institution, which is subordinate to the government, can be established. Professionals, such as administrators, admission officers and dispatchers, can be established to match the scope and workload of the digital governance of the infrastructure.

The closed-loop governance processes, including information collection, case filing, dispatching, processing, feedback and checking, should be set up. The data display and dissemination should be enabled between the public and the institution. The institution publishes or disseminates city management-related policies and activities, and the public can provide feedback via appropriate channels.

8 Data sharing, security and privacy

The digital governance of the infrastructure platform should exchange information with external municipal or professional systems. The data exchange mechanism can facilitate the information exchange among various information systems, for example, open data systems for citizen access. The standardized interfaces need to be provided by the institution, while the data exchange should follow the information exchange standards, thus ensuring the consistency of the information.

All of the collected, used, exchanged and shared information take ISO/IEC 27001, local data security and privacy laws into consideration. The data can be classified and managed according to their sensitivity. The transmission and storage of sensitive data should be managed via an encryption algorithm. Based on the security level of data, the information should be encrypted and authenticated; the access should also be recorded and traced.

Annex A
(informative)

Case studies

A.1 Grid city governance information system (Beijing, China)

Project title	Case study of grid city governance information system in Dongcheng District, Beijing, China
Project profile	(1) Project profile With the urbanization process, the area of a city is expanded, and the city management is also enlarged. The conventional model of city management cannot satisfy the needs and the development of the construction of a big city. The conflict between the city development and the management method means a need to design a new city management model. On October 22, 2004, the new model of grid city management (referred to as digital city management) was initiated, and the grid city management information system was put into operation, which achieved a remarkable effect. In July 2005, the Construction Ministry (MOHURD) promoted the new model, which was emulated by many cities. (2) How to improve the refinement level of city management with the new grid management model? The new model is the first administrative mechanism that specializes in city management in China, which realizes high-level and long-term management. It mainly includes four methods. — The ten-thousand-meter grid management method. Seventeen streets and 177 communities in Dongcheng District were divided into 2,322 ten-thousand-meter (100×100 m^2) unit grids with geographic information technology. Each unit grid was assigned an information gatherer who was responsible for collecting information and checking processing results. — The component management method. The constituent part of city infrastructure is treated as a component, e.g. municipal engineering facility, transportation facility, amenity and environmental facility, and landscaping facility. Each component is coded and assigned to professional departments, which are responsible for dealing with the event reported by the information collector in time. — The close-loop management method. The model established dual-axis management, which linked data collection, filing, dispatching, processing, feedback and checking, to achieve information synchronization, collaborative work. The model improved efficiency.