International Standard

ISO 37187

Smart community infrastructures — Guidance on data exchange and sharing of city information modelling platform

Infrastructures urbaines intelligentes — Recommandations relatives à l'échange et au partage de données de la plateforme de modélisation des informations urbaines

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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

Under the impetus of global urbanization, smart cities are increasingly becoming a new paradigm for urban development. The deep integration of advanced information and communication technologies (ICT), empowering city management, services and sustainable development is the inevitable direction of urban development to enhance urban operational efficiency and quality of life.

The system of smart cities is complicated, and it is not easy to understand the whole picture. Ensuring the maximization of the interests of numerous stakeholders in the process of achieving sustainable development, efficiency, resilience and security goals of urban development is also a challenge.

The city information modelling (CIM) platform, based on the basic geographic information of cities, collects information models of buildings and infrastructures at different stages. It serves as an integrated platform for the basic operational and information resources for urban planning, construction, management and operation. CIM is the fundamental, critical and substantive information infrastructure of smart cities. As the core carrier of smart city construction, its importance is self-evident and crucial for achieving intelligent and refined urban management.

The data framework of the CIM platform integrates data resources from various departments and systems. It enables information sharing and collaboration between different departments, establishes digital models of various aspects of the city and provides important support for the planning, construction, management, operation and development of smart cities. It also provides support for the core foundation of city infrastructure in various fields such as energy, water resources, transportation and waste. At the same time, specifying the functions and applications of the CIM platform can optimize urban services, contribute to achieving sustainable urban development, improve the quality of life for citizens and promote urban economic prosperity.

ISO/IEC 30182 focuses on the smart city conceptual model (SCCM), which is used to describe data from any department in the city, to discuss how to achieve interoperability between data and addressing the lack of data interoperability. ISO 37156 focuses on the data exchange and sharing of smart city infrastructure, offers a reference for governments, enterprises, organizations and individuals to share urban infrastructure data. At the same time, it also provides a set of methods for governing urban infrastructure data, gives a unified framework for data exchange and sharing, following privacy and security principles. After the data can be exchanged and shared under ISO 37156, the city data can be integrated through the city-level platform, CIM, which can utilize the data value. However, there are also data exchange and sharing when data flows into the CIM platform.

This document, by specifying the data, modelling, basic functions, platform construction and operation of the CIM platform, allows data to play a greater role in the development of smart cities in aspects such as urban planning, construction, management, and operation, based on existing data and ensuring data exchange and sharing.

Smart community infrastructures — Guidance on data exchange and sharing of city information modelling platform

1 Scope

This document provides guidance on the city information modelling (CIM) platform for the information modelling process of smart city construction, operation and maintenance.

This document applies to both building and infrastructure assets. It also applies to the management of the CIM platform and its related applications and scenarios, including community infrastructures, such as transportation, communication, energy, roads and logistics, and the activities of stakeholders (both organizations and citizens) for governments, enterprises, schools, health care and families, etc.

NOTE Annex A outlines case studies on data exchange and sharing using the CIM platform in smart communities.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19101-1, *Geographic information — Reference model — Part 1: Fundamentals*

ISO 19650-1, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling— Part 1: Concepts and principles*

ISO/IEC 20924, *Internet of Things (IoT) and digital twin — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19101-1, ISO 19650-1, ISO/IEC 20924 and the following 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
application programming interface
API
collection of invocation methods and associated parameters used by one piece of software to request actions from another piece of software

[SOURCE: ISO/IEC 18012-1:2004, 3.1.1]

3.2
building information modelling
BIM
use of a shared digital representation of an asset to facilitate design, construction and operation processes to form a reliable basis for decisions

[SOURCE: ISO 19650-1:2018, 3.3.14, modified — The wording “a built asset” has been changed to “an asset”; Note 1 to entry has been removed.]

3.3
city information modelling
CIM
development of digital representations and simulations of a city made up of large quantities of geospatial data, often including real-time data, which enable better city planning and management

Note 1 to entry: The geospatial data are provided using an integration of *building information modelling (BIM)* (3.2) and geographic information systems (GIS).

Note 2 to entry: The real-time data are obtained through extensive use of internet of things (IoT) sensors within the city.

Note 3 to entry: City information modelling (CIM) involves handling large amounts of big data, which is generally brought together using cloud computing.

Note 4 to entry: Artificial intelligence is often used to generate and evaluate different scenarios using city information modelling (CIM) data to help manage the city better.

[SOURCE: IEC SRD 63273-1:2023, 3.1.1]

3.4
digital twin
DT_w
digital representation of a target entity with data connections that enable convergence between the physical and digital states at an appropriate rate of synchronization

Note 1 to entry: Digital twin has some or all of the capabilities of connection, integration, analysis, simulation, visualization, optimization, collaboration, etc.

Note 2 to entry: Digital twin can provide an integrated view throughout the life cycle of the target entity.

[SOURCE: ISO/IEC 30173:2023, 3.1.1]

3.5
external information infrastructure
infrastructure of systems, technologies, and frameworks that support integrating and interacting a city's data with external data sources and services

3.6
lightweight model
suitable rendering dataset after simplifying, compressing, and processing of the *synthetic model’s* (3.9) data on geometry, texture, attributes based on lightweighting, visual effect enhancement, and other technologies to optimize the model’s memory usage, computation and power consumption for running on resource-constrained devices

3.7
machine learning
ML
process of optimizing model parameters through computational techniques, such that the model's behaviour reflects the data or experience

[SOURCE: ISO/IEC 22989:2022, 3.3.5]

3.8
open data platform
a digital infrastructure of enabling the collection, storage, sharing and analysis of publicly accessible urban data

3.9
synthetic model
outcome dataset based on format conversion, model classification and grading, data fusion, automated modelling, semantic processing, and other technologies, containing clear semantic composition, geometric form, attribute information and relationship information

4 Overview of CIM platform

4.1 General

The CIM platform is a comprehensive platform that integrates multidimensional data and information of cities, aiming to provide decision support for urban planning, construction, management and services. The CIM platform achieves efficient management and application of data by integrating various urban data resources, thus facilitating sustainable urban development.

The CIM platform centralizes the management of CIM data, providing access interfaces for data and services. The CIM platform's service scope includes but is not limited to urban planning and design, infrastructure construction, environmental protection, public services and emergency management. By offering data support and analysis tools, the CIM platform assists relevant departments and enterprises in optimizing resource allocation, enhancing urban management efficiency and improving service quality.

The target scope of CIM platform services encompasses cities, industrial parks, parks, communities, clusters of buildings and individual buildings. For government and urban management departments, the CIM platform objects can also include various smart facilities and systems such as railways, emergency response, drainage, streets, parking, utilities, facilities, fire protection, communities and industrial parks based on the actual conditions of smart city applications.

4.2 Platform architecture

4.2.1 General

The CIM platform comprises five layers (device layer, data layer, service layer, application layer and user layer) and three supporting systems (standards and specifications system, information security system, and operation and maintenance guarantee system). Horizontally, there are dependencies between the upper and lower layers, such as dependencies of basic resource, data, service and function among different layers. Vertically, there are constraints between vertical systems and related layers, such as interface constraints, security constraints, resource constraints, performance constraints and compatibility constraints. Each layer carries out specific functions and tasks, and through dependency and constraint relationships, the integrity and collaboration of the platform are ensured.

4.2.2 Device layer

The device layer serves as the physical foundation of the CIM platform, encompassing various hardware devices such as sensors, monitoring devices, computing equipment, communication facilities and other hardware components.

The device layer includes IoT sensor devices, open data platform, as well as external information infrastructure such as cloud server, cloud storage, network infrastructure, blockchain and other related components.

The primary function of the device layer is to collect, store, and transmit various data related to urban operations, providing raw data sources and computing services for the data layer above.

4.2.3 Data layer

The data layer is the core of the CIM platform, responsible for storing, processing and managing the data within the CIM.

The data layer includes spatiotemporal fundamental data, resource survey data, IoT sensory data, public thematic data, engineering construction project data, planning control data, outcome data and other datasets.

Constructing the CIM platform data resource system ensures the accuracy, completeness and availability of data, providing data support for the services in the upper layers.

4.2.4 Service layer

The service layer provides various data processing and analysis services, serving as the middleware of the CIM platform.

The service layer provides various common foundational computations and services, including AI-based DT_w, simulation and ML.

The service layer provides functionalities and services such as basic functions, data ingestion, data processing, data fusion, data storage, model management, IoT supervision, API, visualization, dashboard and simulation.

4.2.5 Application layer

The application layer refers to a series of applications and service components built on top of the basic functionalities and services of the CIM platform, catering to specific urban management and decision support demands. It serves as the implementation layer for concrete business functionalities, such as smart government services, smart healthcare and smart buildings applications.

The application layer should be divided into several categories, including urban planning and design applications, construction management and engineering collaboration applications, urban management and operation applications, public service and public participation applications, data analysis and decision support applications, etc. These applications leverage the data and service resources provided by the CIM platform and are extended through secondary development to establish smart applications on desktop, web and mobile platforms.

The application layer serves as the crucial bridge connecting the core technology of the platform with the final user demands. By constructing specialized, customized, and user-friendly application software, general tools and standardized interfaces, it transforms the powerful functionalities of the CIM platform into effective means to solve real urban problems. This fosters the scientific, refined and intelligent management of cities, providing application services in areas such as urban planning, construction, management, services and operations according to user needs.

4.2.6 User layer

The user layer represents the ultimate service recipients of the CIM platform, including government entities, enterprises and the general public.

The user layer includes both mobile users and static users.

The function of the user layer is to interact with the CIM platform through user interfaces to obtain the required information and services. Users can communicate with the middleware layer via wired or wireless networks to complete necessary tasks. The platform provides personalized tools and services tailored to the roles of government entities, enterprises and the general public. Additionally, it adapts to various terminals such as large screens, PCs and mobile devices to meet the needs of users for visual effects and interaction methods.

4.2.7 Supporting systems

Supporting systems ensure that the CIM platform adheres to essential standards and fulfils fundamental recommendations concerning its architecture, operation and maintenance. These supporting systems comprise three key components: the standards and specifications system, the information security system, and the operation and maintenance guarantee system.

— Standards and specifications system: This system specifies data standards, business standards and technical management to ensure the standardized operation of the CIM platform and alignment with national and industry data standards and technical specifications.

— Information security system: This system safeguards the data security and privacy protection of the CIM platform to mitigate various security threats based on relevant national policies and national network security-level protection standards.

— Operation and maintenance guarantee system: This system ensures the stable operation of the CIM platform's network, data, applications, and business processes, necessary technical support and the provision of maintenance services, along with the establishment of operation, update, and security assurance systems.

Figure 1 illustrates the overall architecture of the CIM platform with five layers and three supporting systems.

NOTE In Figure 1, the shaded area refers to the foundational part of CIM platform.

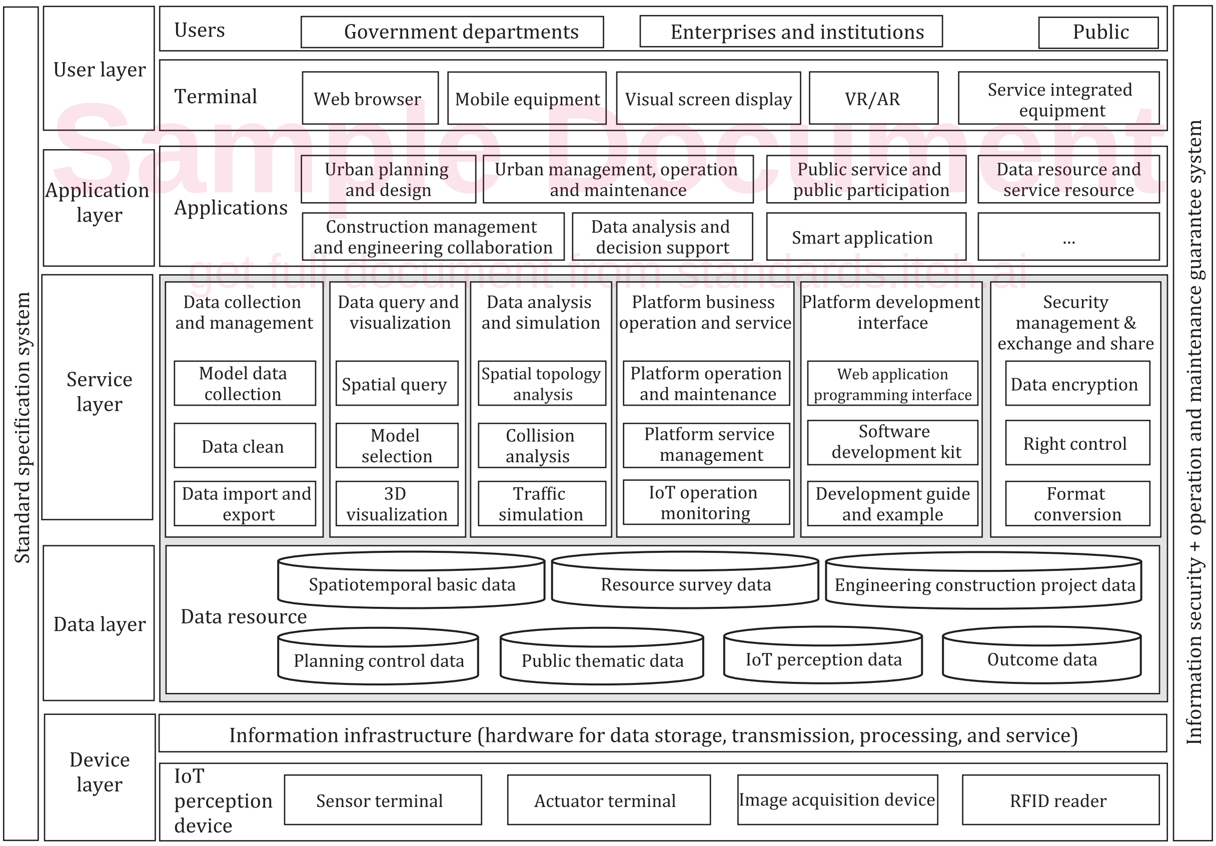

Figure 1 — Architecture of CIM platform

4.3 Implementation recommendations

4.3.1 General

The purpose of construction is to promote collaboration and information sharing among stakeholders.

The CIM platform data governance project and data services should be closely intertwined with cross-departmental business collaboration.

The data layer and the service layer are the foundation part of the CIM platform, and its design should align with the overall framework to ensure effective integration and application of data. The CIM platform infrastructure should meet the recommendations for data updates and business expansion.

The functions of the CIM platform include data collection and management, scenario configuration, data querying and visualization, statistical analysis and application, data sharing and exchange, and operational management interface. These functionalities of the CIM platform should be closely integrated with the overall framework to achieve synergistic collaboration between different layers, thereby enhancing the overall performance and service quality of the platform.

4.3.2 CIM platform use cases

CIM platform scenarios encompass a range of information generated by activities in various urban infrastructure sectors. Common use cases include transportation, communication, energy, buildings, roads, governance, schools and households. The application of models serves the function of verifying whether the models and their applications comply with international standards for urban development. CIM platform applications are evaluated by stakeholders based on their professional expertise, data management and data interoperability.

The construction of CIM platform application scenarios should consist of the following stages:

a) stakeholder analysis, including stakeholder identification and gathering of their specific needs and expectations;

b) data recommendations and integration, including data type identification, integration support and data standards for interoperability;

c) functional recommendations, such as data visualization, analytics and simulation, decision support, collaboration, user interface and user experience;

d) non-functional recommendations, such as scalability, performance, security and interoperability;

e) technical architecture, including modular design architecture, cloud integration, APIs, software development kits (SDKs) and edge computing;

f) compliance and standards, aligning with local regulations and urban development policies;

g) data governance, including data ownership definition, access control policies, data-sharing agreements among stakeholders and implementation of a data governance framework to ensure data quality, accuracy and integrity;

h) use cases and scenarios, such as traffic management, emergency response, environmental monitoring, energy optimization and urban planning;

i) training and support;

j) sustainability and future-proofing.

The construction of CIM platform application scenarios covers the entire process from data source to final user service for a given application, emphasizing high standards in aspects such as data quality, model accuracy, functional suitability, system integration, user experience and information security. The aim is to ensure that CIM platform application scenarios effectively support refined urban management, intelligent decision-making and public services.

4.3.3 Scalability and open interfaces

The application of CIM platform spans the entire process of urban development and is based on real-world conditions.