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Part 3: Smart city engineering framework

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
3.1 General terms 1
3.2 Abbreviated terms 2
4 Smart city engineering framework **2**
4.1 Introduction 2
4.2 Overview of the smart city engineering framework 2
4.3 Security and privacy protection system 4
4.4 Construction system 5
4.5 Operation and maintenance system 5
4.5.1 General 5
4.5.2 Planning 5
4.5.3 Implementation 5
4.5.4 Check 6
4.5.5 Improvement 6
4.6 Identification system 6
4.7 Positioning system 6
4.8 Data acquisition layer 6
4.8.1 General 6
4.8.2 Sensor data acquisition 7
4.8.3 Human data acquisition 9
4.9 Network communication layer 9
4.9.1 General 9
4.9.2 General functions 9
4.10 Computing and storage layer 10
4.10.1 General 10
4.10.2 Computing resource 10
4.10.3 Storage resource 10
4.10.4 Software resource 11
4.11 Data and services supporting layer 12
4.11.1 General 12
4.11.2 Data integration 12
4.11.3 Service integration 13
4.12 Smart application layer 15
Bibliography **16**

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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 Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

A list of all parts in the ISO/IEC 30145 series can be found on the ISO website.

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

0.1 General

The purpose of this document is to assist city chief information officers (CIO) and other stakeholders in planning and implementing a smart city. It comprises the following three parts:

— Part 1: Smart city business process framework

— Part 2: Smart city knowledge management framework

— Part 3 (this document): Smart city engineering framework

Each of the three parts is aimed at a different role or viewpoint within the city and thus separate focus needs to be maintained. The "separation of concerns" is a principle for the development of a city as it uses ICT to deliver the vision and objectives for the city. The value of using the separation of concerns is to simplify development and maintenance of the architecture as the city both develops and delivers improved outcomes for the city stakeholders.

Figure 1 shows the components of the smart city ICT reference framework, which consist of 5 components: stakeholders, vision and outcomes, the business process framework, the knowledge management framework, and the engineering framework. While stakeholders, vision and outcomes, and the engineering framework are described in this document, the business process framework and knowledge management framework are described in ISO/IEC 30145-1:—[1)] and ISO/IEC 30145-2:—[2)], respectively.

1) Under preparation. Stage at the time of publication: ISO/IEC DIS 30145-1:2020.

2) Under preparation. Stage at the time of publication: ISO/IEC DIS 30145-2:2020.

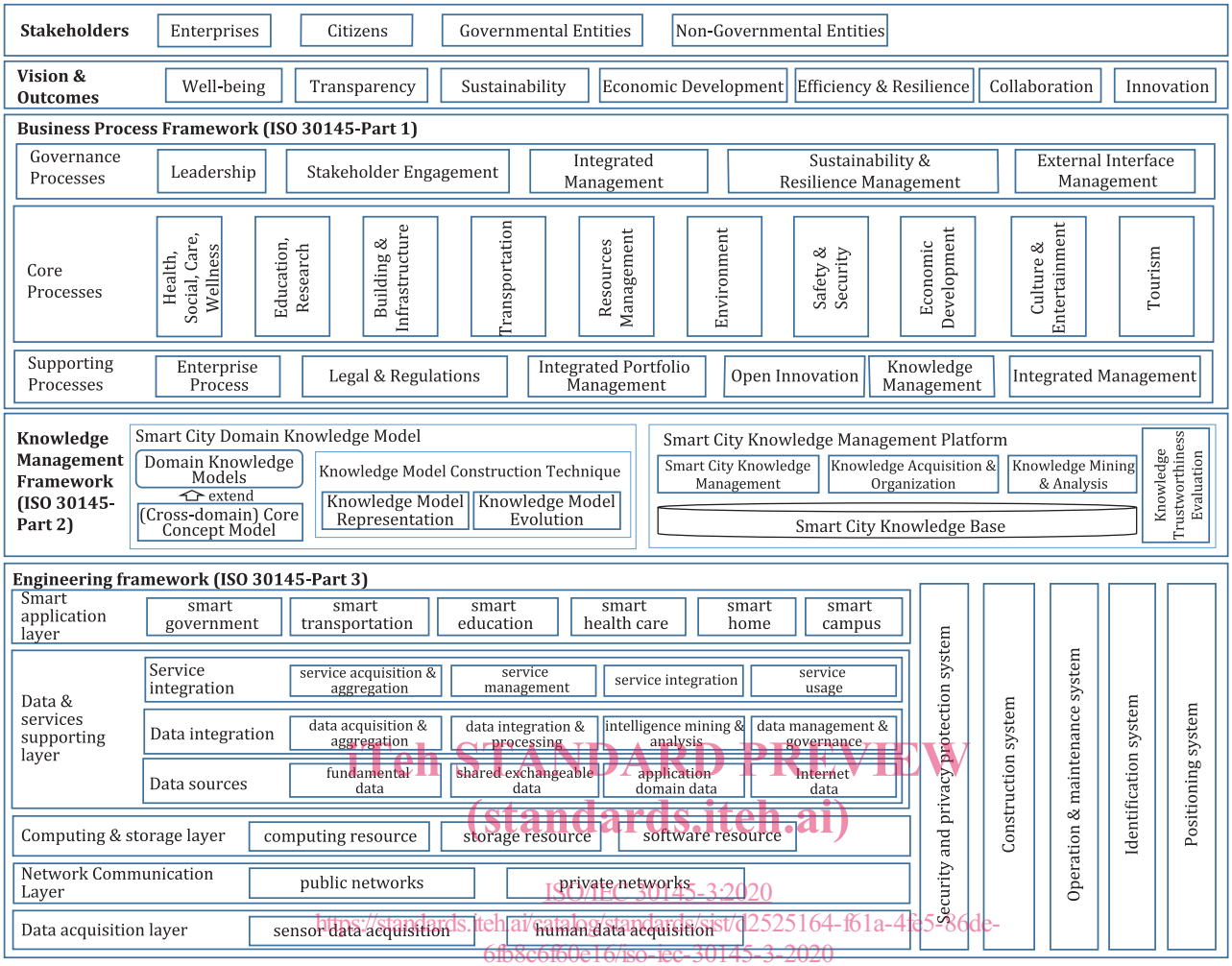

Figure 1 — Smart city ICT reference framework

0.2 Stakeholders

The stakeholders served by the smart city ICT reference framework are businesses, citizens, government organizations and non-government organizations. This stakeholder list is not exhaustive but defines the key stakeholders in a smart city and the user for the smart city ICT reference framework.

0.3 Vision and outcomes

The motivation of making a city smart is a result of a shared vision and a set of agreed outcomes from all of the city stakeholders. The vision and outcomes of the smart city ICT reference framework are well-being, transparency, sustainability, economic development, efficiency and resilience, collaboration and innovation. This vision and outcomes list is not exhaustive but defines the key vision and outcomes of a smart city. The smart city ICT reference framework articulates a vision that the smart city will be transparent in the delivery of city services which meet city sustainability ambitions. This vision uses collaboration and innovation approaches to deliver desired city outcomes. City outcomes are expected to improve efficiency and resilience of city services and promote economic development activities which enhance the well-being of citizens.

Information technology — Smart City ICT reference framework —

Part 3:
Smart city engineering framework

1 Scope

This document describes a framework, structured in layers of ICT technologies, essential for smart cities' operation. This framework also provides the mapping of the ICT techniques to various system entities in order to support the smart city's business, knowledge management, and operational systems from the engineering perspective.

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 http://www.electropedia.org/

3.1 General terms

3.1.1
data
symbols and signals that represent properties of objects, persons, events and their environment

Note 1 to entry: In the English language the term "data" is generally used as a plural noun. For use in the singular, the term "data item" is sometimes used.

3.1.2
information
structured *data* (3.1.1) that are endowed with meaning and purpose

Note 1 to entry: Information is data that have been shaped into a form that is meaningful and useful to human beings.

3.1.3
positioning system
system of instrumental and computational components for determining position

EXAMPLE Inertial, integrated, linear, optical and satellite positioning systems.

[SOURCE: ISO 19116:2019, 3.24]

3.1.4
positional accuracy
closeness of coordinate value to the true or accepted value in a specified reference system

Note 1 to entry: The phrase “absolute accuracy” is sometimes used for this concept to distinguish it from relative positional accuracy. Where the true coordinate value may not be perfectly known, accuracy is normally tested by comparison to available values that can best be accepted as true.

[SOURCE: ISO 19116:2019, 3.22]

3.1.5
heterogeneous computing
system that uses more than one kind of processor or cores

3.1.6
heterogeneous computing resources
combination of hardware and software that can support *heterogeneous computing* (3.1.5)

3.1.7
data integration
process of combining *data* (3.1.1) residing in different sources and providing users with a unified view of them

3.2 Abbreviated terms

WGS84	world geodetic system
GPS	global positioning system
GLONASS	global navigation satellite system
PZ-90	parametry zemli 1990 goda

4 Smart city engineering framework

4.1 Introduction

This document gives descriptions of a Smart city from an engineering perspective. It consists of two parts, the horizontal engineering layers and the vertical systems. For each of the business processes defined and categorized in ISO/IEC 30145-1, a city uses the knowledge defined by the knowledge management framework in ISO/IEC 30145-2. Additionally, the knowledge defined by the knowledge management framework in ISO/IEC 30145-2 is used to understand how the engineering framework is implemented. The function of the horizontal layers is to provide a clear mapping of different techniques and components needed for smart city business processes. The function of the vertical systems is to guarantee the consistency of the technical implementation of a smart city.

4.2 Overview of the smart city engineering framework

Figure 2 shows the smart city engineering framework from the ICT perspective. The framework consists of 5 horizontal layers and 5 vertical cross layer systems with 4 types of smart city stake holders. The five layers are data acquisition layer, network communication layer, computing and storage layer, data and services supporting layer and smart application layer; whereas the five systems are security and privacy protection system, construction system, operation and maintenance system, identification system and positioning system. In addition, the four types of city users are citizens, enterprises, governmental entities and non-governmental entities. The five layers and five systems are introduced in detail in 4.3 to 4.12 respectively.

The data acquisition layer provides the capability to sense the world and take actions. The network communication layer consists of Internet, the telephone network, the cable television network and their convergence. The computing and storage layer includes resources for computing, data storage and foundation software. The data and services supporting layer fuses the data capture capability, communication capability, data storage capability and computing capability into data management and service management capability. The smart application layer offers smart applications and their integrations across industries and domains with support from the layers underneath. The security and privacy protection system addresses the security requirements of a smart city. The operation and maintenance system addresses the ability of a smart city to operate and maintain its IT services. The construction system addresses the ability of a smart city to transit its IT services into sustainable operations for design, planning, construction, maintenance and other aspects of smart city needs. The identification system provides all layers of the engineering framework with identification services. The positioning system is one of the basic systems in a smart city providing inertial, integrated, linear, optical and satellite positioning services.

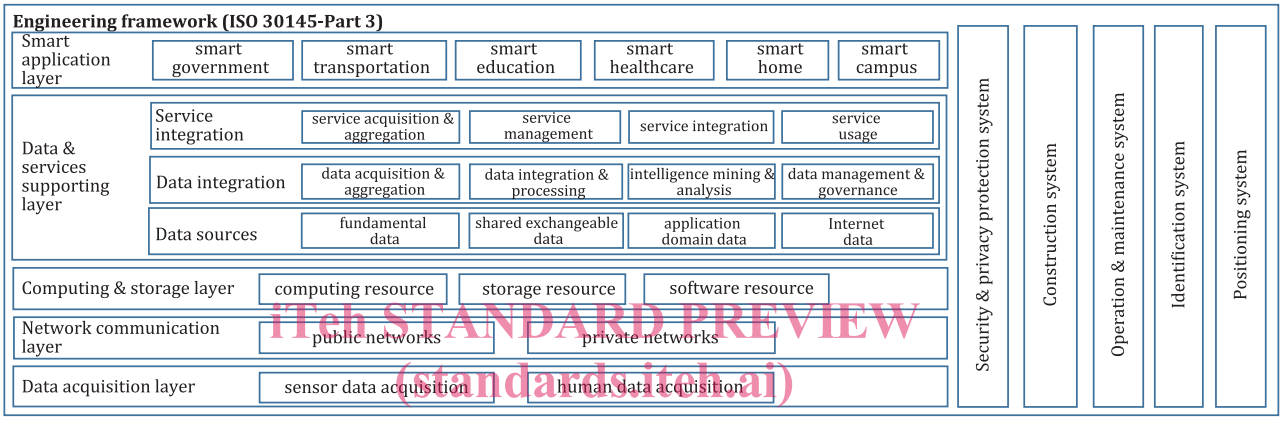

Figure 2 — Smart city engineering framework

From the six-domain IoT Reference Model (RM) and Reference Architecture (RA) in ISO/IEC 30141, the entities in the smart city engineering framework, which is a layer-based framework, shown in Figure 2, can be mapped as shown in Table 1.

Table 1 — Mapping of the layers and entities in the smart city engineering framework to the six domains of ISO/IEC 30141 IoT RA

ISO/IEC 30141 IoT RA	Smart City Engineering Framework		
Domain	**Layer**	**Sub-layer**	**Entities**
User Domain (UD)	stakeholders (not identified within the Engineering Framework)	NA	— Not specified in the Engineering Framework; but in takeholders. They are: — business entities; — citizens; — government organizations; and — non-government organizations

Table 1 *(continued)*

ISO/IEC 30141 IoT RA	Smart City Engineering Framework		
Domain	**Layer**	**Sub-layer**	**Entities**
Operation & Management Domain (OMD)	data & services supporting layer	service integration	— service management — service integration — service usage
		data integration	— data management & governance
Application & Service Domain (ASD)	smart application layer	N/A	— smart government — smart transportation — smart education — smart healthcare — smart home — smart campus
	data & services supporting layer	service integration	— service acquisition & aggregation
		data integration	— data integration & processing — intelligent mining & analysis
	computing & storage layer	N/A	— computing resource — storage resource — software resource
Resource Access & Interchange Domain (RAID)	data & services supporting layer	data resources	— fundamental data — shared exchangeable data — application domain data — Internet data
	computing & storage layer	N/A	— computing resource — storage resource — software resource
Sensing & Controlling Domain (SCD)	data & services supporting layer	data integration	— data acquisition & integration
Physical Entity Domain (PED)	smart application layer		— physical entities in each application domain, e.g., transportation, healthcare, etc.
	data & services supporting layer	data acquisition & aggregation	— physical entities being monitored for data acquisition

4.3 Security and privacy protection system

The security and privacy protection system addresses security requirements such as confidentiality, integrity and availability. It provides authentication, authorization, non-repudiation, user and role identity management, integrity, audit, security monitoring, incident response and security policy

management. This system is applicable to the design, planning, construction, maintenance and other aspects of the ICT systems of a smart city. This includes protecting the confidentiality and rights of individual citizens[9].

4.4 Construction system

The construction system provides the capabilities of design, planning, construction maintenance and other aspects of a smart city.

4.5 Operation and maintenance system

4.5.1 General

The operation and maintenance system provides an overall plan for the operation and maintenance services capabilities; provides necessary resources to implement operation and maintenance service capabilities, management and services content; ensures the quality of delivery to meet service level agreement requirements; carries out supervision, measurement, analysis, evaluation and improvement of operation and maintenance service results and service delivery processes. Existing standards for ICT service operation and maintenance, such as the ISO/IEC 20000 series, can be used by a smart city. Subclauses 4.5.2 to 4.5.5 summarize that approach to service operation and maintenance[3].

4.5.2 Planning

Planning includes the following aspects:

1. planning operation and maintenance service objects and requirements according to the business location and capacity, and forming a service catalogue;
2. establishing the appropriate organizational structure and management system following the service catalogue;

3. implementing operation and maintenance team, processes, and goals, carry out personnel, resources, technology and process planning, and establishing adapted assessment methods and a service support system;
4. planning to manage, review and improve the quality of service, and establish internal review and evaluation mechanisms.

4.5.3 Implementation

Implementation includes the following aspects:

1. developing an overall implementation plan, and performing according to the overall implementation plan;
2. establishing a communication and coordination mechanism with demand-side;
3. creating appropriate documentation to ensure the traceability of implementation; ensuring documentation results can be evaluated and measured;
4. constructing an operation and maintenance centre responsible for implementing system monitoring, operation command, maintenance, equipment management, service response and other functions;
5. creating the ability to monitor the operational state of hardware, control systems, applications from the data acquisition layer, the network communication layer, the computing and storage layer, the data and services supporting layer, the smart application layer, and responding in a timely manner.