

DRAFT INTERNATIONAL STANDARD

ISO/DIS 37105

ISO/TC 268

Secretariat: **AFNOR**

Voting begins on:
2018-07-09

Voting terminates on:
2018-10-01

Sustainable cities and communities — Descriptive framework for cities and communities

Développement durable des collectivités — Cadre descriptif pour les villes et les collectivités

ICS: 13.020.20

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Reference number
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Published in Switzerland

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1 Foreword

2 ISO (the International Organization for Standardization) is a worldwide federation of national standards
3 bodies (ISO member bodies). The work of preparing International Standards is normally carried out
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5 committee has been established has the right to be represented on that committee. International
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7 collaborates closely with the International Electrotechnical Commission (IEC) on all matters of
8 electrotechnical standardization.

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

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16 the ISO list of patent declarations received (see www.iso.org/patents).

17 Any trade name used in this document is information given for the convenience of users and does not
18 constitute an endorsement.

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

23 This document was prepared by Technical Committee ISO/TC 268, *Smart and Sustainable Cities and*
24 *Communities*.

25 This is the first edition of this standard.

26 A list of all parts in the ISO 37100 series can be found on the ISO website.

27 **Introduction**

28 The Descriptive Framework for Cities and Communities detailed in this document helps city and
 29 community stakeholders define a common language to describe cities and communities. This Framework
 30 can facilitate the sharing of ideas, data and solutions within, and also between, cities. The Descriptive
 31 Framework, which can also be referred to as the city anatomy, serves as a basic blueprint to facilitate the
 32 integration of operating systems and services within a city or community.¹ Ultimately, the Descriptive
 33 Framework can be the basis of a formal ontology—or knowledge model—which can be useful for helping
 34 to plan and implement city operating solutions, particularly for those cities operating solutions and
 35 services that may require digital machine-readable information.

36 A city or community is a system of systems and interactions that fosters emergent human behaviour.² It
 37 can be seen as an arrangement of, and set of relationships between, the multiple layers of a permanent
 38 human settlement, with an administrative and legal status supported by laws and generally recognized
 39 throughout the world. Rather than being static, discreet entities, cities or communities often have porous
 40 and sometimes ambiguous borders (politically, economically, environmentally, and socially) and can thus
 41 often be difficult to describe. The structure, interactions, and societal aspects of a city or community are
 42 also integral parts of all wider systems of systems extending beyond the city borders. However, more
 43 than half the world's population now lives in cities or communities and many of humanity's chronic
 44 challenges are faced in cities or communities. A common descriptive framework for cities or communities
 45 is a useful tool to assist them in sharing knowledge and finding solutions to issues common to cities or
 46 communities all over the world.

47 Solutions to the issues cities face should improve the quality of life for all city citizens and follow
 48 sustainable development principles. Those principles dictate that the solutions to city issues
 49 implemented today do not compromise the ability of future generations to meet their own needs. The
 50 United Nation's Sustainable Development Goals (UNSDG)³ issued in 2015 resolve this relatively abstract
 51 ideal into more tangible objectives. The UNSDG Goal 11 provides these objectives for cities, creating 10
 52 targets for improving the quality of life for citizens and the city's resiliency, while also limiting the impact
 53 of human activity on the environment. Tools such as ISO standards, such as ISO 37101 and ISO 37120,
 54 help cities plan for, monitor, and reach these objectives. The purpose of this document is to provide a

¹ See: City Protocol Society, *City Anatomy: A Framework to Support City Governance, Evaluation, and Transformation*

² Emergent Human Behavior: its existence and activities are ad hoc and therefore unique to the event. These are small or large groups that take shape and carry out tasks or activities that institutionalized groups cannot accomplish. Thus the emergent organized response (people sometimes speak of 'emergent groups' too), is related to the idea of non-traditional and new behavior (example of mutual assistance groups that form just after a catastrophe to look for the injured and help evacuate them). While the informal emergent groups are generally organized in the period after the disaster and more rarely during the event, during which period individuals organize their actions more around their families and friends (Quarantelli, 1988), institutionalized groups, whether emergent or not, act both during and after the event.

EMERGENT HUMAN BEHAVIOR DURING A DISASTER: THEMATIC VERSUS COMPLEX SYSTEMS APPROACHES Damienne Provitolo, Edwige Dubos-Paillard and Jean-Pierre Muller EPNACS- September, 2011

³ **Sustainable Development Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable:** (11.1) By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums; (11.2) By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons; (11.3) By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries; (11.4) Strengthen efforts to protect and safeguard the world's cultural and natural heritage; (11.5) By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations; (11.6) By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management; (11.7) By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities; (11.a) Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning; (11.b) By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels; (11.c) Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials.

55 common language for the description of cities that will enable those goals and support the sharing of city
56 solutions.

57 The Descriptive Framework is based on work by the City Protocol Society. It uses an analogy to human
58 anatomy and its dynamic physiology to describe any city or community, of any size, in a manner that is
59 timeless, culturally agnostic, scalable, and generic. The Descriptive Framework categorizes the
60 components of the city into three major elemental systems: a set of physical structures (Structure), the
61 living entities that create a city's society (Society), and the flow of interactions between them
62 (Interactions). These elemental systems are further resolved into—or described by—layers that capture
63 all the activities of importance to the city, both within and outside of the city boundaries as well as all the
64 natural and built domain components within a city.

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65 Sustainable cities and communities — Descriptive framework for 66 cities and communities

67 1 Scope

68 This international standard specifies requirements for a descriptive framework including an associated
69 foundational ontology of the anatomical structure of a city or community. The descriptive framework has the
70 following qualities: *timeless*, i.e., compatible with any human settlement at any time in history; *acultural*,
71 i.e., valid for any culture and any type of city; *scalable*, i.e., valid for a metropolis, a city, a small town, or a
72 village; and *generic*, so that everything we could define as a “human settlement”, such as a “smart city”, would
73 have a place in this structure.

74 2 Normative references

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

78 [ISO 37100:2016](#), Sustainable cities and communities – Vocabulary

79 3 Terms and definitions

80 For the purposes of this document, the following terms and definitions apply. ISO and IEC maintain
81 terminological databases for use in standardization at the following addresses:

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

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

84 3.1

85 Descriptive Framework

86 A logical structure that describes how the key entities within a specific domain can be classified so as to show
87 their relationship with each other.

88 Note: “Entities” refers not only to tangible things, but also to anything important that has a separate and
89 distinct existence — for instance: elemental conventions, principles, practices, strategies, policies, decision
90 making structures, and accountabilities.

91 3.2

92 Ontology

93 A specification of concrete or abstract things, and the relationships among them, in a prescribed domain of
94 knowledge.

95 [ISO/IEC TR 19763-9:2015]

96 3.3

97 Stakeholder

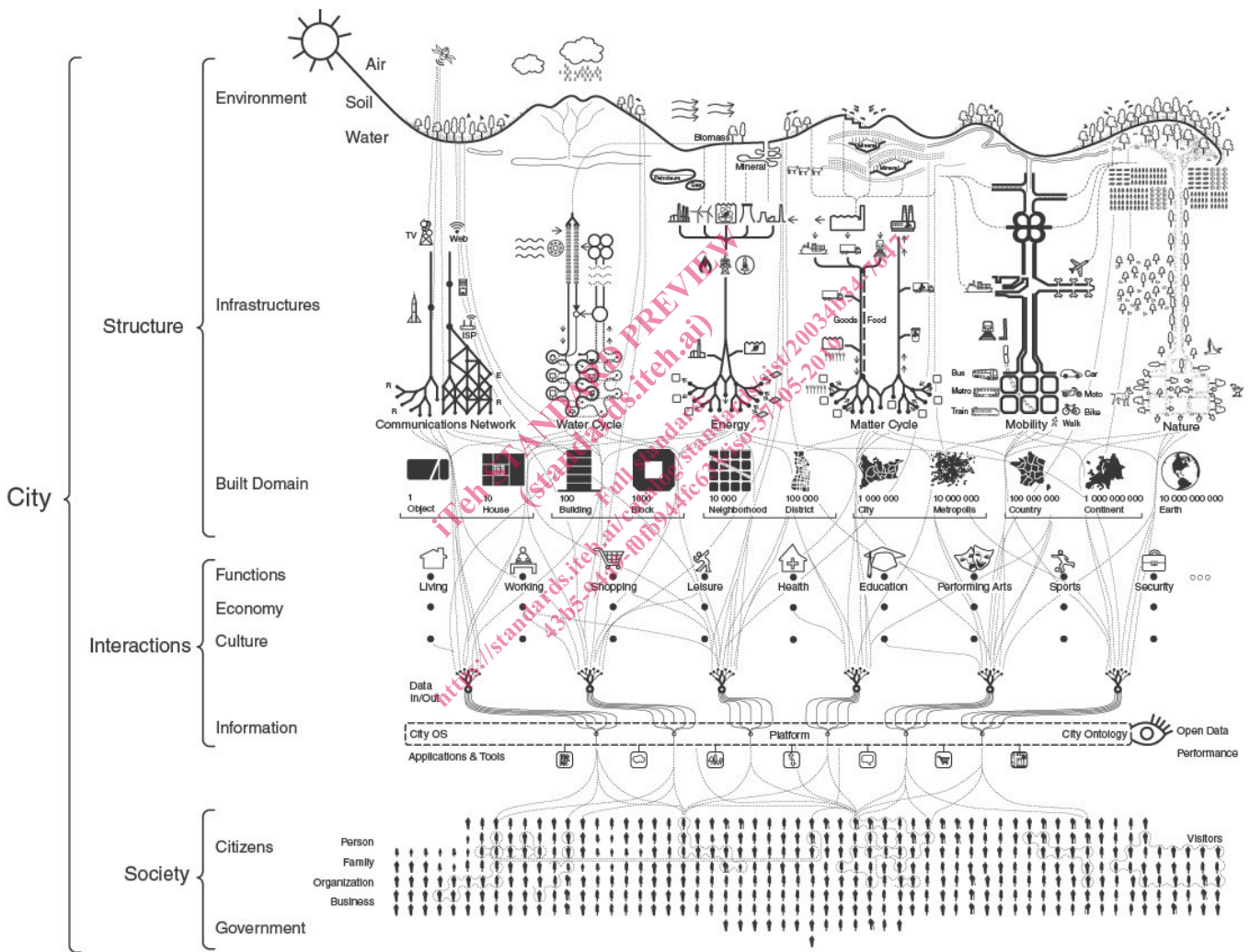
98 Any person or organization that can affect, be affected by, or perceive themselves to be affected by a decision
99 or activity.

100 **3.4**
 101 **Urbanism**
 102 Urban life and environment.

103 **4 Descriptive Framework of Cities and Communities**

104 **4.1 General description of the City**

105 Figure 1 shows the three overarching logical elements of any city or community ecosystem as the holistic
 106 integration of: the physical structure (**Structure**), the people who live in it and occupy this physical space
 107 while carrying out functions (**Society**), and the **Interactions** through which the Society engages with the
 108 Structure.



109
 110 **Figure 1 — A timeless, culturally agnostic, scalable, generic descriptive framework for any city or**
 111 **community**

112 **4.2 Cities as Ecosystems**

113 Cities can best be viewed and understood as an ecosystem, which shall be broken down into three elements⁴:

- 114 • The *physical structure* of that ecosystem;

⁴ http://en.wikipedia.org/wiki/Ramon_Margalef

- 115 • The *living entities* that it contains; and
- 116 • The *flow of interactions and information*.

117 The Descriptive Framework offers a common language to describe the city ecosystem as: a set of physical
118 structures, the living entities that make up a city's society, and the flow of interactions between them. In so
119 doing, it suggests an analogy to the human anatomy and its dynamic physiology.

120 **4.3 How the Descriptive Framework supports governance and transformation**

121 Ultimately, the Descriptive Framework aims to help enable effective governance, evaluation, and
122 transformation by providing city officials and other stakeholders:

- 123 • A way to describe their aims and objectives, existing or proposed city initiatives, and services in a
124 manner that is consistent across cities, vendors, and service providers, and standards developers;
125 and
- 126 • A comprehensive checklist of key city aspects and domains.

127 By providing a framework for describing projects and objectives in a way that is consistent with other cities,
128 city solution providers and standards organisations will enable them to more easily:

- 129 i. Identify opportunities and potential areas for innovation and collaboration within or between cities;
- 130 ii. Improve communications between different city service owners and/or operators within the city;
- 131 iii. Communicate their objectives and priorities clearly to citizens and service providers;
- 132 iv. Frame and support emerging processes and citizen demands; and
- 133 v. Identify the standards that are most relevant to the needs they are seeking to address.

134 The checklist can help them:

- 135 i. Review their city in a comprehensive way to evaluate areas of strengths and weaknesses and set
136 priorities for future action;
- 137 ii. Review potential projects to understand the areas of city life they are likely to impact and the city
138 stakeholders that need to be consulted or involved; and
- 139 iii. Develop comprehensive sets of evaluation criteria to judge the success of projects.

140 **4.4 Basic elements of the Descriptive Framework for Cities and Communities**

141 **4.4.1 Structure (system)**

142 The first layer within the Structure system element is the *Environment*, which is the physical and geographic
143 setting of the city, including the natural environment ("nature"). It is formed by the three basic components—
144 air, earth, and water—interacting dynamically in a seasonally variable way and increasingly subject to the
145 impacts of climate fluctuations linked to anthropogenic greenhouse gas pollution.⁵ The second layer of the
146 Structure system element is *Infrastructures*, the connective structures that enable resource gathering and
147 extraction from the environment, transporting resources to the city, and the material and energy cycles
148 within the city itself. These infrastructures include those that support *communications*, the *water and energy*
149 *cycles*, the *matter cycle* that supports the movement of goods and food as well as the resultant waste, the
150 *mobility networks*, and *nature* or green infrastructure of the city. The third layer is the *Built Domain*, which
151 can best be organized according to the approximate number of people that it can accommodate on a physical

⁵ Anthropogenic sources are those caused or produced by humans, such as the carbon pollution emitted through power generation or transport.

basis. Thus, within the *Built Domain*, an *object* corresponds to a *single person, house, building, block, neighborhood, district, city, and metropolis or region*, each increasing the scale by an order of magnitude. Private and public spaces are contained within each level of scale.

4.4.2 Interactions (system)

The first layer within the Interactions system element comprises urban *Functions* including *living, working, education, shopping, caring for health, the performing arts*, and many more. The second layer is the *Economy*, which influences urban innovation and the everyday operation of the city, as well as the life cycles of services provided by cities. The third layer is *Culture* — the languages, traditions, beliefs, values, and the ways in which people organize their conceptions of the world around them (i.e., the non-material assets of the city). The fourth and final layer is *Information*. It includes the *City Operating System (City OS), City Performance Indicators and Indexes, Tools and Applications, City Ontology*, and an *Information Portal* for open data and specific learning protocols and related resources.

4.4.3 Society (system)

The Society system element is composed of the living entities of the city. The first layer is *Citizens*, which can be broken down into: *person (the individual), family, organizations, and businesses*. The second layer is *government*, whose head is, typically, the mayor.

Note: The term *governance* will be used when the Descriptive Framework of a City is used for evaluation purposes. The term *governance* is the process of running a government and, as such, it focuses on its effectiveness.

4.5 Structure (system)

4.5.1 Environment

The first subsystem layer within the structure system element of the Descriptive Framework (see Figure 1) is the environment, the setting of the city, as shown in Figure 2.

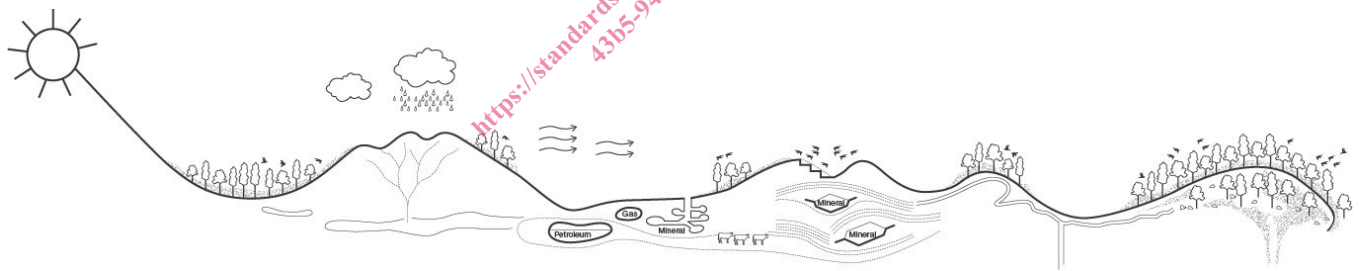


Figure 2 — Environment

The environment existed well before the establishment of the city and includes the topography, morphology, living systems, and natural flows and cycles that form the city’s physical setting. The environment is the nature (plants and animals) and the three basic components—air, soil and water—which interact dynamically in seasonally variable ways. Each of these components has its own indicators to assess quality and other characteristics.

Air quality can be assessed by measuring particulate concentration, ozone levels, and other chemistry, as well as CO₂ levels, temperature, and other measures related to global warming. The ground topography (*soil*) is fundamental for siting a city and serves as an important resource, supporting agriculture, plants, and animals. It is also an important source of minerals and energy. *Soil* too has physical and chemical properties, which can be measured. Finally, *water* cycles through the environment—atmosphere to surface water to groundwater to oceans. Both water quality and water quantity can be measured in a number of ways.

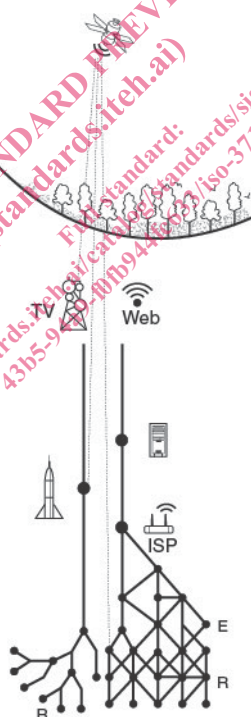
188 These are the components, which interact to form the Environment Layer and are critical in the functioning
 189 of a city.

190 4.5.2 Infrastructures

191 The second subsystem layer within the Structure System Element is the **Infrastructures**, the connective
 192 structures that enable resource extraction and use, as well as enabling city life. The infrastructure layer
 193 includes the networks that support communications and mobility, as well as those that support cycles for
 194 water, energy, and matter. It also includes the natural—or green—infrastructure that plays an important role
 195 in many communities.

196 4.5.2.1 Communications Network

197 The first Infrastructure depicted in Figure 1 above is the communications network shown in detail in Figure
 198 3. The communications component is composed of all of the technologies that carry information, such as
 199 Information Communication Technologies (ICT) (wire and cellular telephone technologies, radio, television)
 200 and the Internet. Centralized models of communication with one emitter and many receivers (i.e., radio and
 201 television) have evolved into a more distributed arrangement of information with many emitters and many
 202 receivers of information (i.e., the Internet). Telecommunications networks transporting information through
 203 copper and/or fiber optic cables, as well as through the electromagnetic spectrum, are all examples of
 204 Communication Infrastructure.



205
 206 **Figure 3 — Communications Network**

207 4.5.2.2 Water Cycle

208 The second Infrastructure is the water cycle component, which includes water supply, treatment, and
 209 management of wastewater, surface water runoff, and floodwaters (see Figure 4). Cities draw water from the
 210 environment, perform treatment process, and consume it. Gray-water⁶ and wastewater is discharged back
 211 into receiving bodies, often after treatment, and sometimes recycled directly back into the community's own

⁶ Gray-water is wastewater from sinks, baths, washing machines, and other sources that can be used—recycled—for uses that do not require potable water, like toilet flushing.