TECHNICAL SPECIFICATION

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Smart community infrastructures — Principles and requirements for performance metrics

Infrastructures communautaires intelligentes — Principes et exigences pour la métrique des performances

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Foreword

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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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The committee responsible for this document is ISO/TC 268, *Sustainable development in communities,* Subcommittee SC 1, *Smart community infrastructures*.

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Introduction

Communities have various goals to achieve, including, e.g. quality of life, economic growth, poverty reduction, antipollution, congestion mitigation.

Community infrastructures such as energy, water, transportation, waste, information and communications technology (ICT), etc. are fundamental to support the operations and activities of communities. Investment in community infrastructures is an important enabler for communities in achieving the internationally recognized community goals, e.g. the United Nations Millennium Development Goals (MDGs)[1] and promoting pro-poor growth.[2] The demand for community infrastructures will continue to expand significantly in the decades ahead, driven by major factors of change, such as population growth, and urbanization. According to the Organization for Economic Co-operation and Development (OECD) report "Infrastructure 2030," total cumulative infrastructure requirements amount to about USD 53 trillion over 2010/2030.

It has long been argued that human activity is surpassing the capacity of the Earth. The imperative for further infrastructure (e.g. improving living standards and addressing resource efficiency) sometimes conflicts with a path to sustainability. As a result, there is a need for community infrastructures to contribute to sustainability and resilience of communities more effectively and efficiently by balancing multiple perspectives and integrating decision making. Such solutions are often referred to as "smart." A number of plans and projects to build "smart cities" are currently underway. In addition, there are increases in international trade for community infrastructure products and services including solution-providing services.

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ISO deliverables are an important source of technological information. ISO deliverables help governments and businesses of all shapes and sizes to work more efficiently, increase productivity, increase credibility and confidence, and access new markets. For example, as they define the performances that products and services have to meet in the global markets, ISO deliverables help developing countries or small and medium-sized enterprises (SMEs) take part fairly in international trade.

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The purpose of standardization in the field of smart community infrastructures is to promote the international trade of community infrastructure products and services and disseminate information about leading-edge technologies to improve sustainability in communities by establishing harmonized product standards. The users and associated benefits of these metrics are illustrated in Figure 1.

This Technical Specification gives principles and specifies requirements for community infrastructure performance metrics and gives recommendations for analysis of community infrastructures.

It is expected that this Technical Specification will be useful to the following individuals/groups:

— national and local governments;

— regional organizations;

— community planners;

— developers;

— community infrastructure operators (e.g. in the field of energy, water, transportation, waste, ICT);

— community infrastructure vendors (e.g. constructors, engineering firms, system integrators or component manufacturers);

— non-governmental organizations (e.g. consumer groups).

---

1) All 193 United Nations member states and at least 23 international organizations have agreed to achieve these goals by 2015. One of the main outcomes of the Rio+20 Conference was the agreement by member States to launch a process to develop a set of Sustainable Development Goals (SDGs), which will build upon the Millennium Development Goals and converge with the post 2015 development.

2) Stimulate economic growth for the benefit of poor people (primarily in the economic sense of poverty).

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Using a model of the community functions in Table 1, this Technical Specification focuses on assessing the performance of infrastructure layer and respects the societal or cultural diversity of communities as traits of each community.

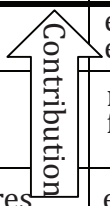
As illustrated in Table 1:

— Functions of community infrastructures are fundamental to support the other two layers.

— Products and services of community infrastructures are more technology-oriented and more internationally-tradable than those in other layers and therefore appropriate for international standardization.

Table 1 — Layers of a community

Layers	Examples of functions
Community services	education, healthcare, public safety and security, tourism, etc.
Community facilities	residences, commercial buildings, office buildings, factories, hospitals, schools, recreation facilities, etc.
Community infrastructures	energy, water, transportation, waste, ICT, etc.
[SOURCE: ISO/TR 37150:2014, Introduction]	



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NOTE 1 Because of the diversity of communities, it is not realistic to apply 'one-size-fits-all' solutions.

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NOTE 2 This Technical Specification considers not only built or constructed community infrastructures but also utilization of natural systems (e.g. green infrastructure which uses natural hydrologic features to manage water and provide environmental and community benefits).

NOTE 3 This Technical Specification recognizes two types of ICT: The first type is the ICT as community infrastructures, e.g. telecommunication, common database, etc. The second type is the ICT which are integrated within a facility or equipment as a means for control. This Technical Specification is focused on the former type of ICT although the latter type of ICT is often a useful means to achieve smart communities or smart community infrastructures.

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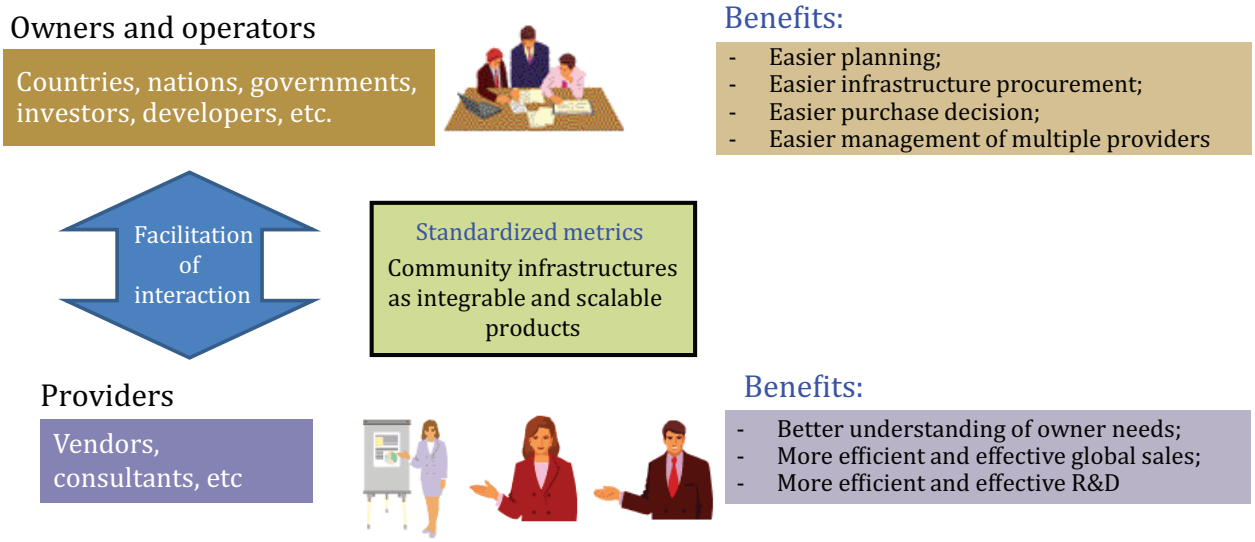

NOTE SOURCE: ISO/TR 37150:2014, "Introduction", modified.

Figure 1 — Users of the metrics and associated benefits

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Smart community infrastructures — Principles and requirements for performance metrics

1 Scope

This Technical Specification gives principles and specifies requirements for the

— definition,

— identification,

— optimization, and

— harmonization

of community infrastructure performance metrics, and gives recommendations for analysis, including

— smartness,

— interoperability,

— synergy,

— resilience,

— safety, and

— security

of community infrastructures.

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Community infrastructures include, but are not limited to, energy, water, transportation, waste, and ICT.

The principles and requirements of this Technical Specification are applicable to communities of any size sharing geographic areas that are planning, commissioning, managing, and assessing all or any element of its community infrastructures. However, the selection and the importance of metrics or (key) performance indicators of community infrastructures is a result of the application of this Technical Specification and depends on the characteristics of each community.

In this Technical Specification, the concept of smartness is addressed in terms of performance relevant to technologically implementable solutions, in accordance with sustainable development and resilience of communities as defined in ISO/TC 268.

NOTE 1 This Technical Specification recognizes that solutions for similar problems in communities in different economic situations (e.g. developed and developing countries) can call for different importance of metrics or performance indicators of community infrastructures. This Technical Specification is not a recommendation document for best practices. This Technical Specification does not recommend, e.g. replicating existing specific smart infrastructures or leveling them up to the standards of such model projects at a large scale. It is left to the users whether setting targets or not when applying this Technical Specification.

NOTE 2 Though this Technical Specification does not address principles or requirements specific to a particular type of community infrastructures, compatibility of this Technical Specification with existing International Standards for a particular type of community infrastructure (e.g. ISO 24510:2007, ISO 24511:2007, and ISO 24512:2007) was considered.

NOTE 3 This Technical Specification does not address measurement, reporting or verification. For possible deliverables related to this Technical Specification, see ISO/TR 37150:2014, Clause 6. This Technical Specification is not into comparing different communities, but to allow communities to assess community infrastructures more effectively.

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2 Normative references

There are no normative references.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
community
group of people with an arrangement of responsibilities, activities and relationships

Note 1 to entry: In the context of this Technical Specification, a community shares geographic areas.

[SOURCE: ISO 24510:2007, 2.7, modified and adapted to sustainable development and resilience of communities.]

3.2
community infrastructure
system of facilities, equipment and services that support the operations and activities of communities

Note 1 to entry: Such community infrastructures include, but are not limited to, energy, water, transportation, waste and information and communication technologies (ICT).

[SOURCE: ISO 9000:2005, 3.3.3 "infrastructure," modified and adapted to communities.]

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3.3
smart community infrastructure
community infrastructure with enhanced technological performance that is designed, operated, and maintained to contribute to sustainable development and resilience of the community

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Note 1 to entry: It is the community infrastructure that is considered to be "smart" in this Technical Specification and not the community.

Note 2 to entry: Sustainable development tends to require community infrastructures that meet multiple, often contradictory, needs at a same time.

Note 3 to entry: Information and communication technologies (ICT) is an enabler but not a precondition for achieving smart community infrastructures.

3.4
sustainability
state of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs

Note 1 to entry: The environmental, social, and economic aspects interact, are interdependent and are often referred to as the three dimensions of sustainability.

Note 2 to entry: Sustainability is the goal of *sustainable development* (3.5).

[SOURCE: ISO Guide 82:2014, 3.1]

3.5
sustainable development
development that meets the environmental, social, and economic needs of the present without compromising the ability of future generations to meet their own needs

Note 1 to entry: Derived from the Brundtland Report.

[SOURCE: ISO Guide 82:2014, 3.2]

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3.6
environment
surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation

Note 1 to entry: Surroundings in this context extend from within an organization to the global system.

[SOURCE: ISO 14050:2009, 3.1]

3.7
environmental impact
any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects

[SOURCE: ISO 14001:2004, 3.7]

3.8
interoperability
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

[SOURCE: ISO 21007-1:2005, 2.30]

3.9
life cycle
consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal

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[SOURCE: ISO 14044:2006, 3.1]

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3.10
life-cycle cost

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total investment in product development, manufacturing, test, distribution, operation, support, training, and disposal

[SOURCE: ISO/IEC 26702:2007, 3.1.21]

3.11
metric
the defined measurement method and the measurement scale

[SOURCE: ISO/IEC 14598-1:1999, 4.20, modified — Note 1 and Note 2 have been removed.]

3.12
pro-poor growth
stimulate economic growth for the benefit of poor people (primarily in the economic sense of poverty)

Note 1 to entry: Pro-poor growth can be defined as absolute, where the benefits from overall growth in the economy, or relative, which refers to targeted efforts to increase the growth specifically among poor people.

EXAMPLE A pace and pattern of economic growth that helps poor women and men to participate in, contribute to and benefit from.

[SOURCE: OECD, 2008]

3.13
provider
person or organization involved in or associated with the delivery of products and/or services

[SOURCE: ISO/TR 12773-1:2009, 2.40, modified.]

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3.14
safety
freedom from unacceptable risk

[SOURCE: ISO/IEC Guide 51:2014, 3.14, modified.]

4 Overview

4.1 Outline

This subclause provides an overview of Clause 4 to Clause 6 and annexes of this Technical Specification.

4.2 indicates possible uses of this Technical Specification.

Clause 5 specifies the principles which provide the conceptual backbone to the definition, identification, optimization, and harmonization of community infrastructure performance metrics. In the understanding of requirements and guidance described in Clause 6, these principles shall be read first by all readers of this Technical Specification because this clause is the conceptual backbone to the whole document including requirements.

Clause 6 provides the requirements and guidance for defining, identifying, optimizing and harmonizing smart community infrastructure performance metrics. 6.1 introduces a step-wise approach to identify community infrastructure performance metrics as a requirement. 6.2, 6.3, 6.4, and 6.5 provide requirements and guidance of conducting each step of the approach required in 6.1.

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Annex A provides examples of the applicability of the step-wise approach to existing key performance indicators for specific types of community infrastructures.

Annex B provides an example of relating community issues onto community infrastructure performances.

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4.2 Possible use

4.2.1 General

This subclause describes non-exhaustive possible uses of this Technical Specification. The users and associated benefits of these metrics are illustrated in Figure 1.

4.2.2 Support tool for community managers

This Technical Specification is intended to be used as a support tool for community managers, e.g.:

— to align the relationship between community issues and infrastructure performances;

— to prioritize investments in new community infrastructure and areas for improvement in existing community infrastructures among the different types of community infrastructures (e.g. to point out where to reach the highest effectiveness for investments in the community infrastructure by taking multiple perspectives into account);

— to identify metrics applied for the purpose of measurements of dynamic data that allow management and feedback to improve the community in terms of utilization and sustainability.

4.2.3 Facilitation tool

This Technical Specification is intended to be used as a facilitation tool for both owners and operators, and providers of community infrastructure products and services, e.g.:

— to serve as a framework for discussion on the performances of community infrastructures to be introduced;

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— to provide a common language among multiple stakeholders, including owners and operators, and providers of community infrastructure products and services, by helping identify performance characteristics of community infrastructures to contribute to community priorities when they discuss community issues and the introduction or improvement of community infrastructures;

— to help owners and operators compare multiple proposals of the introduction or improvement of community infrastructure products and services from multiple providers in terms of performances;

NOTE This Technical Specification does not require its users to set targets.

5 Principles

5.1 General

This clause specifies the principles which provide the conceptual backbone to the definition, identification, optimization, and harmonization of community infrastructure performance metrics. 5.2 introduces the ideal properties to be considered in the process of defining or identifying a set of community infrastructure performance metrics. 5.3 requires relating performance characteristics to community issues/priorities. 5.4 addresses the stakeholders of communities to be considered in the definition, identification, optimization, and harmonization of community infrastructure performance metrics.

5.2 Ideal properties to be achieved

In the definition, identification, optimization or harmonization of community infrastructure performance metrics, the following ideal properties of smart community infrastructure performance metrics should be considered:

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— be harmonized;

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— include items useful for as many stakeholders as possible involved in trades of community infrastructure products and services (e.g. local governments, developers, suppliers, investors, and users);

— facilitate evaluation of the technical performance of community infrastructures, contributing to sustainability and resilience of communities;

— be applicable to different stages of the development of communities and community infrastructures;

— reflect the dynamic properties of the community infrastructures;

— be selected with consideration for the synergies and trade-offs of multiple issues or aspects that a community faces, such as environmental impacts and quality of community services. Only addressing a single issue or aspect might not be considered smart;

— focus on advanced features of community infrastructures such as interoperability, expandability, and efficiency rather than the status-quo;

— be applicable to a diverse range of communities (e.g. geographical location, sizes, economic structures, levels of economic development, stages of infrastructure development) and a diversity of individuals within communities i.e. considering full range of people (e.g. age, gender, income, disability, ethnicity, etc.);

— allow consideration of multiple community infrastructures (e.g. energy, water, transportation, waste, ICT) that support the operations and activities of communities;

— allow technologically implementable solutions;

— allow a holistic perspective of multiple community infrastructures. (More specifically, to consider an integrated system which includes the interaction and coordination of multiple community infrastructures);

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— allow evaluation of the technical performance (e.g. efficiency, effectiveness) of community infrastructures rather than characteristics of specific technologies;

— be based on transparent and scientific logic.

NOTE Adapted from ISO/TR 37150:2014, 6.1, modified.

5.3 Relating community issues onto community infrastructure performances

In the definition, identification, optimization or harmonization of community infrastructure performance metrics, performances characteristics to be measured by the community infrastructure performance metrics should be related to community issues. This is to ensure that the identified community infrastructure performance metrics represent the community infrastructure performances that contribute to improve or cope with the community issues which are of interest to the users of this Technical Specification.

NOTE 1 Community issues are challenges that a community faces. Obviously, the issues and their priorities are usually different for different communities.

NOTE 2 Some indicators, e.g. Global City Indicators or United Nations Conference on Sustainable Development (UNCSD) indicators are useful to understand and align community issues.

One possible method to relate community issues with community infrastructure performances is to prepare a table of community infrastructure performance characteristics versus community issues and analyse the relation between the two (For details, see Table 2 and Annex B).

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Table 2 — Informative image of relating table of community issues and infrastructure performances

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Community infrastructure performance characteristics	Community issues				
	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5
Performance characteristics A	***	**	*		
Performance characteristics B	**	**	*		
Performance characteristics C	*	***	*		
Performance characteristics D	*	***	*		

NOTE The number of "*" indicates the degree of relations between the performance listed in the row and the issue listed in the column.

5.4 Possible stakeholders to be considered

In general, a community has multiple stakeholders with multiple interests and it is not easy to meet all of them through conventional approaches. For example, it is easy to increase the convenience of public transportation by increasing the number of services. However, it is difficult to do so while reducing cost and environmental impacts at a same time. Therefore, community infrastructure performance metrics shall be identified in a well-balanced way which covers multiple perspectives of different stakeholders of communities. In the identification of community infrastructure performance metrics, the interests of the following stakeholders should be considered.

NOTE Key stakeholders of community infrastructures might be different for different users of this Technical Specification according to their interests and purposes.

— People or citizens: People or citizens of the community are one of the major users of community infrastructures. Therefore, the diversity of perspectives of people or citizens is essential to identify community infrastructure performance metrics.

— Industry or enterprises: Industries or enterprises which have or plan to have activities in the community are another major type of users of community infrastructures. Therefore, their perspectives are essential to identify community infrastructure performance metrics. In addition,

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interests of industries or enterprises are also essential for community governors and planners because the performance of community infrastructures is an important prerequisite to attract and bring industries or enterprises which play an essential part in the economy and functions of a community.

— Municipalities: Municipalities are usually the administrators that regulate the operation of community infrastructures.

— Infrastructure operators: Because infrastructure operators are the direct providers of community infrastructure services, they are stakeholders to which community infrastructure performances are closely related.

— Product, service, and solution providers: Although product, service, and solution providers are not always the direct providers of community infrastructure services, they provide machines, components, systems, services, and solutions which are necessary for infrastructure operators to provide community infrastructure services. Thus, interests of these stakeholders are also essential to identify community infrastructure performance metrics.

— Financial institutions and investors: As the construction and operation of community infrastructures tend to be large scale, long-span projects, the role of financial institutions and investors are essential. The planned, expected, and achieved performances of community infrastructures will be important for this group of stakeholders as a part of criteria for financing and investment.

6 Requirements for common approach to identify metrics

6.1 General requirements

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The identification of community infrastructure performance metrics shall be conducted through a step-wise approach described below in accordance with the principles introduced in Clause 5.

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Step a) Understand the perspectives of key stakeholders for community infrastructures, which include the views of residents/end-users/beneficiaries/consumers, community managers, and the environment;

Step b) Identify needs which are important from the perspectives determined in a);

Step c) Translate the needs identified in b) into performance characteristics;

Step d) Identify metrics (measurement methods and measurement scales) which are appropriate to measure each of the performance characteristics identified in b) and c).

Table 3 illustrates the identification of community infrastructure performance metrics following this approach.

In step a) of the above approach, perspectives shall be determined so that they represent multiple interests of different stakeholders of communities including residents, community managers, and the environment or the equivalents of these.

NOTE 1 The identified community infrastructure performance metrics using this approach might be different for communities or for different users because the determinations of perspectives and identifications of needs can be different.

NOTE 2 Those stakeholders can be found according to ISO 37120 and ISO 26000.

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