TECHNICAL REPORT

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Systems and software engineering — Framework for categorization of IT systems and software, and guide for applying it

Ingénierie des systèmes et du logiciel — Cadre pour la catégorisation des systèmes et du logiciel de la technologie de l'information et guide pour son application

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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 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 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.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and Systems Engineering*.

This second edition cancels and replaces the first edition (ISO/IEC TR 12182:1998), which has been technically revised.

Introduction

This Technical Report has several purposes which are directed to its various intended audiences in the systems and software engineering community, including the developers and users of systems and software engineering standards.

Since ISO/IEC TR 12182:1998 was published, more than 15 years passed with various changes in Information Technology (IT) arena. Those changes include the following:

— IT evolution by hardware advancement, operating systems growth, and communication network changes;

— advent of new type of applications such as entire enterprise applications including ERP (Enterprise Resource Planning), SCM (Supply Chain Management); social systems including online financial systems, healthcare systems, traffic management systems; embedded systems including car electronics; and highly interactive systems handling multi-media and using mobile technologies such as smart phones and tablet computers;

— Internet becoming one of important lifelines;

— emergence of SaaS (software as a service), big data systems and cloud computing services;

— growing impact of the quality of systems and software, in particular safe and secure manner.

By taking these important situational changes, the role and contribution expected for IT industry becomes dramatically increasing, and in order to respond to these expectation, several improvements to the ISO/IEC TR 12182:1998 are made in this revision as follows:

— the scope is enhanced from software to systems and software;

— a framework for describing categorizations is provided in place of a specific set of categorizations;

— relationship to other International Standards available in systems and software engineering area is added.

The categorization of systems and software itself should evolve over time because systems and software engineering is a fast growing field, and therefore this Technical Report does not provide a specific set of categorizations but a framework for categorizations in contrast to the previous one.

For developers and providers of systems and software technologies such as software products, techniques and tools, and research results, this Technical Report will provide the way to define categories of systems and software to which a particular technology can apply. This will help the technology users sort out a right set of technologies, which are applicable (and effective) in the context of their use.

For developers of systems and software engineering standards, this Technical Report will provide ability to position and prioritize specific usage of standards and clauses within the structure of systems and software engineering standards. It is also intended that, wherever applicable, new or on-going projects can identify and use the target categories to provide guidelines on how to apply the standards in different contexts of use. Addressing target categories will not only ease the coordination among projects but also increase the value of standards for their users.

Systems and software engineering — Framework for categorization of IT systems and software, and guide for applying it

1 Scope

This Technical Report specifies the manner in which categorizations of IT systems and software are organized and expressed. It provides the framework for categorizations, and a guide for applying it. This allows any community to clarify their scope of the systems by using their own definition of categories.

The scope of application of the framework is intended to IT systems and software, including services provided by IT systems, where they can be of main targets but not limited to.

The purpose of this Technical Report includes the following:

a) developers of systems and software engineering standards can define their applicability to different categories of target systems and software using annexes or guidelines, so that their users can easily identify relevant standards and clauses that they can apply;

b) suppliers of systems and software engineering tools and methods can clarify the types of target systems and software to which their technologies are applicable or limited so that their users can easily choose the right tools and methods among many candidates for their use;

c) providers of services can define characteristics of their services using classification axes so that they can specify the quality of their services;

d) developers and evaluators of the systems and software can categorize systems and software of similar characteristics by using classification axes so that they can obtain a better estimation and quality evaluation of their target systems and software to be developed;

e) the systems and software engineering community can exchange their research ideas and best practices with defined scope of application.

This Technical Report does not provide a specific set of categorizations but the framework for categorizations and a guide for applying it to achieve the above purposes.

It is important that standards on systems and software engineering are properly applied to the procurement or development of certain kinds of systems. This Technical Report provides a categorization framework and a guide for applying it to assist in (1) defining the area of application of standards, and (2) positioning new standards. The annex of this Technical Report provides descriptive examples for relevant standards, each of which describes the area of application of the standard by using defined categorization.

NOTE Giving guidance on applicability might not be relevant to all standards.

2 Normative references

No normative references are made for the application of this document.

3 Terms and definitions

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

3.1
stakeholder
individual or organization having a right, share, claim, or interest in the target system and its categorization that meet their needs and expectations

[SOURCE: ISO/IEC 15939:2007, 2.37, “system” replaced by “target system”]

3.2
concern
interest in something relevant to one or more of its stakeholders

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.7, “system” replaced by “something”]

3.3
IT system
system which uses information technologies

3.4
target system
system to be categorized, which can be an IT system and software, including service provided by IT system

3.5
categorization
specific way to allocate a target system into a category

3.6
categorization space
universal set of systems and software which has one or more classification axes as its individual dimension, by which stakeholder’s concerns on categorization are expressed

3.7
classification axis
total range of a mapping of systems and software for categorizing them from a particular perspective

3.8
equivalence class
range on a classification axis which has a rule to judge whether a target system is to be mapped to the range or not

3.9
category
subset of categorization space, which the stakeholders are interested in, specified using a combination of one or more equivalence classes

3.10
architecture
fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution

[SOURCE: ISO/IEC 15288:2008, 4.5]

3.11
environment
<system> context determining the setting and circumstances of all influences upon a system

[SOURCE: ISO/IEC/IEEE 42010:2011, 3.8]

3.12
developer
individual or organization that performs development activities (including requirements analysis, design, testing through acceptance) during the system or software life cycle process

[SOURCE: ISO/IEC 25000:2014, 4.6]

3.13
acquirer
person or organisation that acquires or procures a system, software product, or software service (which may be part of a system) from a supplier

[SOURCE: ISO/IEC 12207:2008, 4.1, modified]

3.14
supplier
organization or individual that enters into an agreement with the acquirer for the supply of a product or service

[SOURCE: ISO/IEC 12207:2008, 4.47]

3.15
independent evaluator
individual or organization that performs an evaluation independently from developers and acquirers

[SOURCE: ISO/IEC 25040:2011, 4.30]

3.16
quality characteristic
category of software quality attributes that bears on software quality

[SOURCE: ISO/IEC 25000:2014, 4.34]

3.17
quality in use
degree to which a product or system can be used by specific users to meet their needs to achieve specific goals with effectiveness, efficiency, freedom from risk and satisfaction in specific contexts of use

[SOURCE: ISO/IEC 25000:2014, 4.24]

4 Framework for categorization

4.1 General

This clause introduces the framework for categorization of IT systems and software, which can be used for mapping target systems into groups based on different stakeholder perspectives. The framework comprises model for categorization (see 4.2) and structure of classification axes (see 4.3).

4.2 Model for categorization

Figure 1 depicts the model for categorization of systems. The model consists of key concepts and the relationship among them, which can be used to define categorizations of specific systems for different stakeholders.

A stakeholder of a categorization has several concerns to accomplish his/her purpose for using the categorization. Stakeholder's concerns on categorization are expressed by a categorization space, on which categories are defined. A classification axis is a range, which has one or more equivalence classes, into either of which a system can be classified. A categorization space is defined with one or more classification axes. A named category is a subset of categorization space which is specified with a combination of one or more equivalence classes.

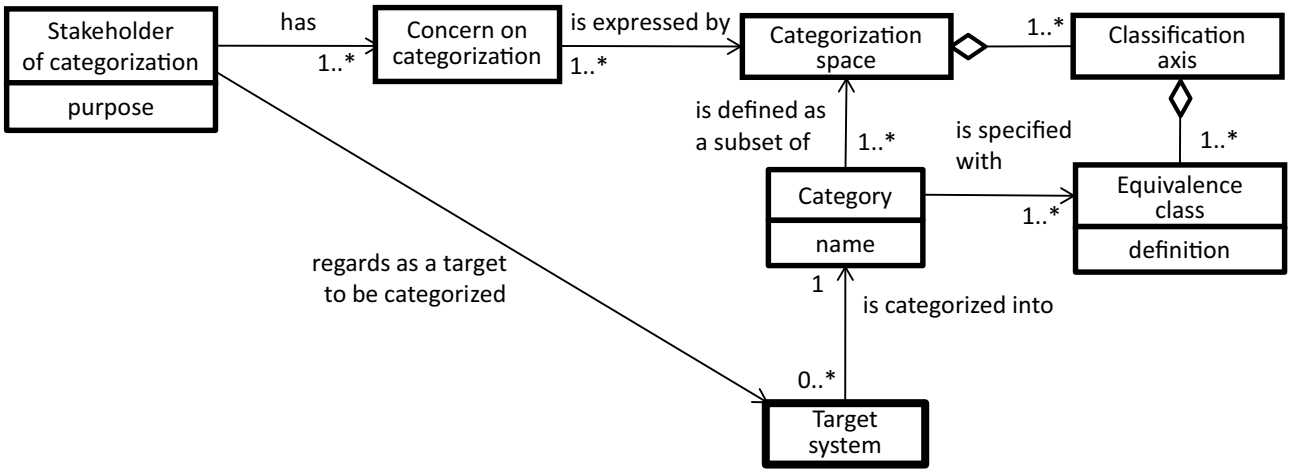

Figure 1 — Model for categorization

For example, if a stakeholder of categorization is interested in "large scale embedded systems" as his/her target category, he/she can define a categorization space with two classification axes: hardware/execution environment and function size, and can specify the target category, as shown in Figure 2.

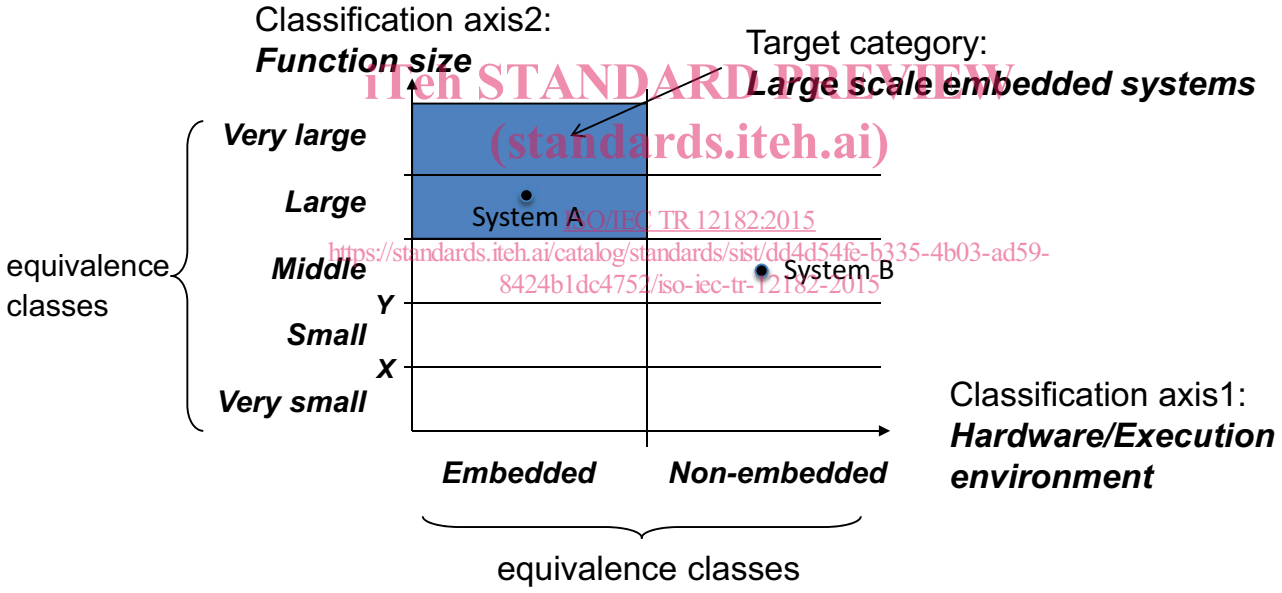

Figure 2 — Example of defining a category using two classification axes

The hardware/execution environment axis has two equivalence classes: Embedded and Non-embedded, each of which has a rule that classify the target system into the class. The rule of the equivalence class "Embedded" can be defined like: the target system must be classified into "Embedded" if it has one or more computers on which software runs for handling specific machines or devices, and that of "Non-embedded" is as the negation of it. On the other hand, the function size axis has continuous ranges and the rule of each equivalence class is defined as an interval on the axis. For example, the equivalence class "Small" can be defined like: the target system is classified into "Small" if its functional size is in the interval X to Y.

In Figure 2, system A is in "Embedded" on the hardware/execution environment axis and is in "Large" on the function size axis, and as a result is classified into the target category "Large scale embedded system", while system B are not. In this manner, any target system can be classified into either of categories on a categorization space.

4.3 Structure of classification axes

This subclause provides the structure of classification axes, which can be used to define specific categories. Figure 3 shows the concepts related to target systems, which can be considered when identifying classification axes.

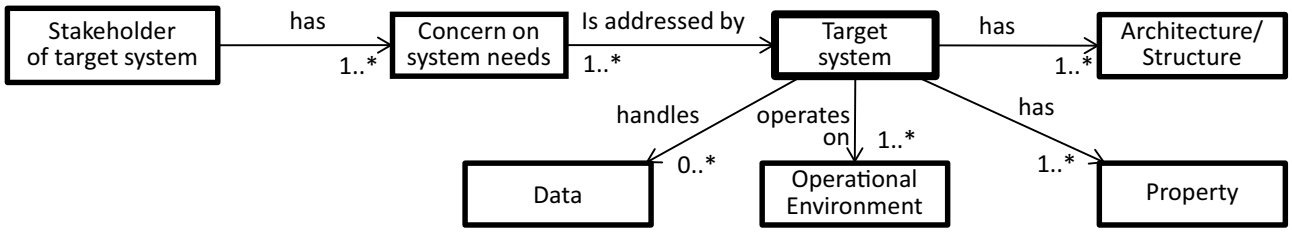

Figure 3 — Concepts related to systems which lead to classification axes

Target systems address stakeholder concerns. Target systems also have their own architectures/structures and properties, operates on some operational environments, and handles data. These aspects have (both external and internal) contribution to the classification axes related to target systems.

NOTE The stakeholder of a target system may be the same as the stakeholder of a categorization.

Classification axes are hierarchically organized, as described in Figure 4.

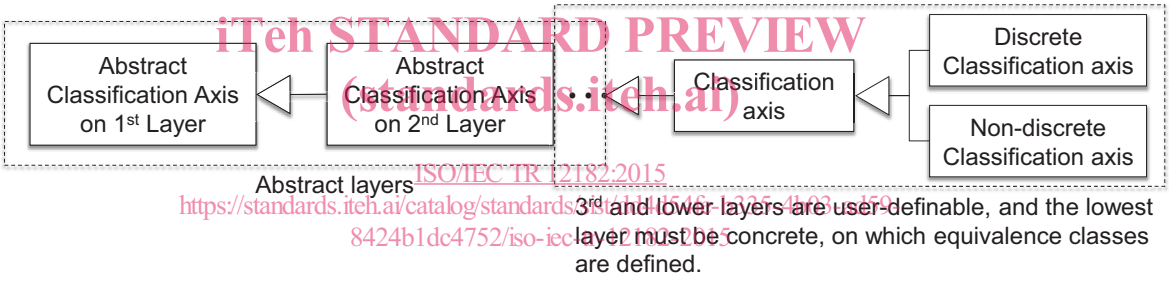

Figure 4 — Hierarchy of classification axes

Classification axes on the first layer are intended to cover possible classification axes for categorizing target systems. Axes on this layer are abstract in the sense that they can be used only for categorizing classification axes; i.e., they do not have equivalence classes and therefore cannot be used directly for creating a categorization space.

Table 1 defines the classification axes on the first layer, which are originated from the concepts in Figure 3.

Table 1 — Definition of classification axes in the first layer

Axis in the first layer	Definition
Architecture/Structure	Axes from the viewpoint of system architecture/structure. In case that the target system is one of the components composing a larger system, the axes are identified from the relations among the components.
Property	Axes from the viewpoint of the properties of the system. The axes are identified from the attributes or computational styles that the system itself or its software has.
Operational environment	Axes from the viewpoint of the operational environment on which the system operates
Data (Property of data)	Axes from the viewpoint of the data that the system mainly handles. The axes are identified from the type, property or variety of the data.