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TRAINING ACADEMY

Beginner 1

Course 8

STANDARDISATION TRAINING ACADEMY

Topic:

CLASSIFICATIONS OF STANDARDS

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Authors:
Ivana Mijatovic, Biljana Tosic
University of Belgrade, Faculty of Organisational Sciences

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Module Objectives

After completing this module, you should be able to:

1. understand the need for the classification of standards;
2. understand subject-matter-related classifications;
3. understand classifications related to standards development;
4. understand classifications related to standards use;
5. explain the differences between de jure and de facto standards;
6. explain the differences between horizontal and vertical standards; and
7. understand that standards developed by professional and industrial associations, business associations, consortia, and fora may eventually become formal standards.

Key Terms

basic standards, business/marketing standards, classic standards, closed standards, common standards, company standards, compatibility standards, consortium standards, de facto standards, de jure standards, design-based standards, functional standards, generic standards, governmental standards, horizontal standards, information/measurement standards, licensed standards, management system standards, measurement standards, minimum quality/safety standards, non-licensed standards, non-public standards, one-sided standards, open standards, operational standards, performance-based standards, process standards, product standards, public standards, regulatory standards, requiring standards, sectoral standards, service standards, standards for testing, variety-reducing standards, vertical standards, voluntary standards

About The Authors

Ivana Mijatovic

University of Belgrade in Serbia

Ivana Mijatovic is a full professor at the University of Belgrade, Faculty of Organisational Sciences. She has focused on standardisation and quality management for much of her academic career. She has developed standardisation courses at bachelor and master levels and is a passionate teacher of standardisation and ICT standardisation. She serves as a vice president on the board of the European Academy for Standardisation EURAS (www.euras.org). In 2018/2019, she was the Chair of the International Cooperation for Education Board about Standardisation ICES (http://www.standards-education.org/). In 2017/2019, she was a member of a working group related to the EU Joint Initiative on Standardisation (JIS Action 3). Since 2015, she has been a member of the STARTed team (Team of Specialists on Standardisation and Regulatory Techniques – education on standardisation) of The United Nations Economic Commission for Europe (UNECE). She is a member of the national mirror committee KS I1/07 – Software engineering, IT for Education and Internet, at the Institute for Standardisation of Serbia. The list of her publication can be found at the following link: https://www.researchgate.net/profile/Ivana_Mijatovic.

Biljana Tosic

University of Belgrade in Serbia

Biljana Tošić is a Teaching Assistant and a Research Assistant at the Faculty of Organisational Sciences, University of Belgrade. She earned a B.Sc. and M.Sc. in Quality Management and Standardisation and another M.Sc. in Human Resources Management at the same Faculty. She is currently a Ph.D. Candidate, working on a doctoral dissertation titled ''The significance of the expertise in standardisation for the internationalisation of SMEs''. To date, she has been engaged in teaching several courses at the Faculty: Fundamentals of Quality, Standardisation 1, Metrology with the Fundamentals of Engineering, Normative Regulation of Quality, and Accreditation and Certification. She has been a member of the organisational board of the World Standards Cooperation Academic Day 2019 and the International Cooperation for Education about Standardisation (ICES) WorkShop 2019. She has been a member of the technical board of the International Symposium SymOrg 2020 titled ''Business and Artificial Intelligence'' and the SymOrg 2022 titled ''Sustainable Business Management and Digital Transformation: Challenges and Opportunities in the post-COVID Era''. She has been engaged in project III 47003 ''Infrastructure for technology-enhanced learning in Serbia'', supported by the Ministry of Education, Science, and Technological Development of the Republic of Serbia (2017-2020). She has been Editor in Chief of the Quality Media Station, the first media centre for quality established within the TEMPUS project titled ''Enhancement of Quality Infrastructure in Western Balkan Countries (EQIWBC)'' (2015-2017). She is currently a member of the National Mirror Committee Conformity Assessment & Quality Management KS CASCO at the Institute for Standardisation of

Serbia (National Technical Committee related to ISO/CASCO, ISO/TC 176, ISO/TC 176/SC 1, ISO/TC 176/SC 2, ISO/TC 176/SC 3, ISO/TC 283, CEN/SS F20, CEN/TC 279, CEN/TC 379, CEN/TC 381, CEN/TC 389, CEN/CLC/JTC 1, and CEN/CLC/JTC 4).

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1 THE NEED FOR CLASSIFICATIONS OF STANDARDS

Although the standardisation literature offers various classifications of standards, many of these classifications seem to be unsystematic. [1] A systematic classification might be beneficial for SDOs, as they could describe standardisation projects, develop criteria to determine if standards are within their scope, and enhance the identification of standards. [2] The same author added that a systematic classification might be beneficial for SDOs users, as well. [3]

Standards classifications can be classified as (see Fig. 1.): [4]

- subject-matter-related classifications,
- classifications related to standards development, and
- classifications related to standards use.

2 SUBJECT-MATTER-RELATED CLASSIFICATION

According to the subject, standards can broadly be classified as: [5]

- **product standards** cover different characteristics of products mostly considering their quality, safety, and even their interoperability with other related products;
- **service standards** cover different characteristics of services aimed at ensuring a bare minimum of quality and safety during the provision of services, and specifying all the rights and responsibilities of all parties involved in the provision of services;
- **process standards** cover conditions under which products are being produced; and
- **management system standards** assist organisations to achieve the requirements that are specified in the product and process standards.

Considering that standards usually concern entities and relations between entities, de Vries argued that subject-matter-related classifications can also be classified as: [6]

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[1] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 159.
[2] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 160.
[3] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 160.
[4] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 5.
[5] Stroyan, J., & Brown, N. (2012). Using Standards to Support Growth, Competitiveness and Innovation. In *Guidebook Series: How to Support SME Policy from Structural Funds.* (October). https://doi.org/10.2769/42198, pp. 14.
[6] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards

- classifications related to the differences between entities; and
- classifications related to the requirements;

2.1 CLASSIFICATIONS RELATED TO THE DIFFERENCES BETWEEN ENTITIES

Classifications related to the differences between entities classify standards according to:

- **a problem of interrelated entities**; and
- **the level of generalization**.

According to a problem of interrelated entities, standards can be classified as: [7]

- standards related to solving a problem of interrelated persons (e.g. standards defining guidelines and instructions, or standards related to management systems);
- standards related to solving a problem of interrelated physical objects
- (e.g. standards defining relations between screws and nuts or plugs and sockets);
- standards related to solving a problem of interrelated persons and physical objects (e.g. standards defining specific occupational safety or ergonomic requirements);
- standards related to solving a problem of interrelated persons and virtual objects:
  - terminology standards (e.g. language used related to a system or a process);
  - standards used to describe a system (e.g. symbols for flow charts);
  - standards used to design a system (e.g. standard programming languages);
  - standards for user interfaces and ergonomics; and
  - personal identification and biometric standards; and
- standards related to solving a problem of interrelated virtual objects (e.g. software applications compatibility standards).

According to the level of generalization, standards can be classified as: [8]

and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 5.

[7] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 5.

[8] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 5.

- **horizontal standards** set general requirements for a collection of different entities (e.g. standards for electromagnetic compatibility (EMC) of electrical and electronic equipment or standards for bio-compatibility criteria of medical devices);
- **vertical standards** set several requirements for one kind of entity (e.g. standards for a specific electronic device such as a PC monitor or a keyboard or standards for a specific medical device such as a transfusion apparatus/device or medical gloves);

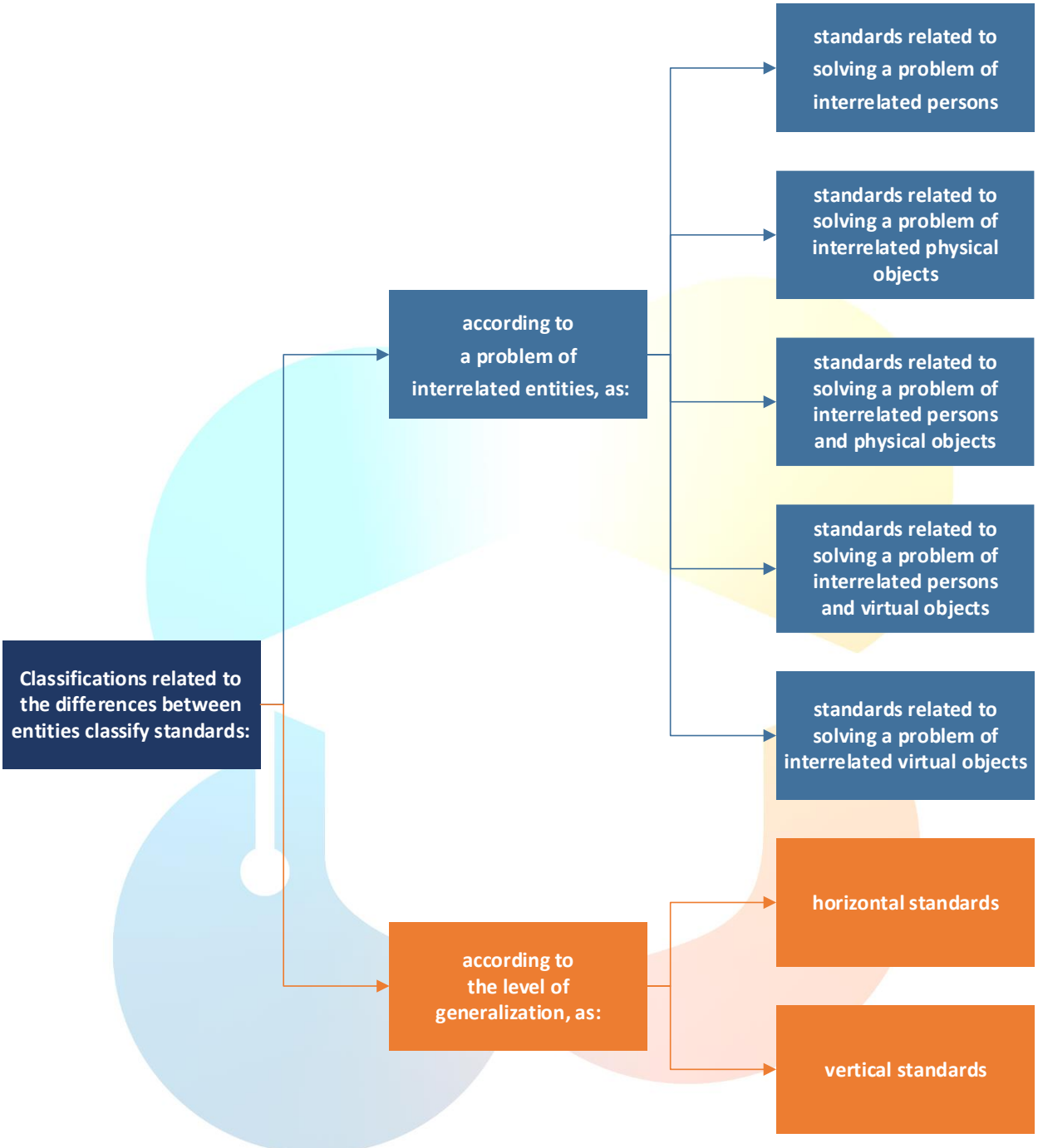

Fig. 1. Classifications related to the differences between entities

2.2 CLASSIFICATIONS RELATED TO THE REQUIREMENTS

Classifications related to the requirements classify standards as: [9]

- **basic standards** give structured descriptions (aspects of) interrelated entities to encourage communication about these entities and the use among other standards:
  - terminology standards;
  - quantities and units standards;
  - classifications and codes standards;
  - systematic data standards;
- **requiring standards** set requirements for entities or relations between entities. Two subcategories can be defined as: [10]
  - **performance-based standards** set performance criteria for the solution(s) to a matching problem; these standards do not prescribe solutions but can specify the extent to which deviations from basic requirements are allowed;
  - **design-based standards** describe the solution(s) to a matching problem;
- **measurement standards** describe methods to be used to check if requiring standards criteria have been met.

[9] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 6.

[10] Tassey, G. (2000). Standardisation in technology-based markets. *Research Policy*, *29*(4–5). https://doi.org/10.1016/S0048-7333(99)00091-8, pp. 587–602.

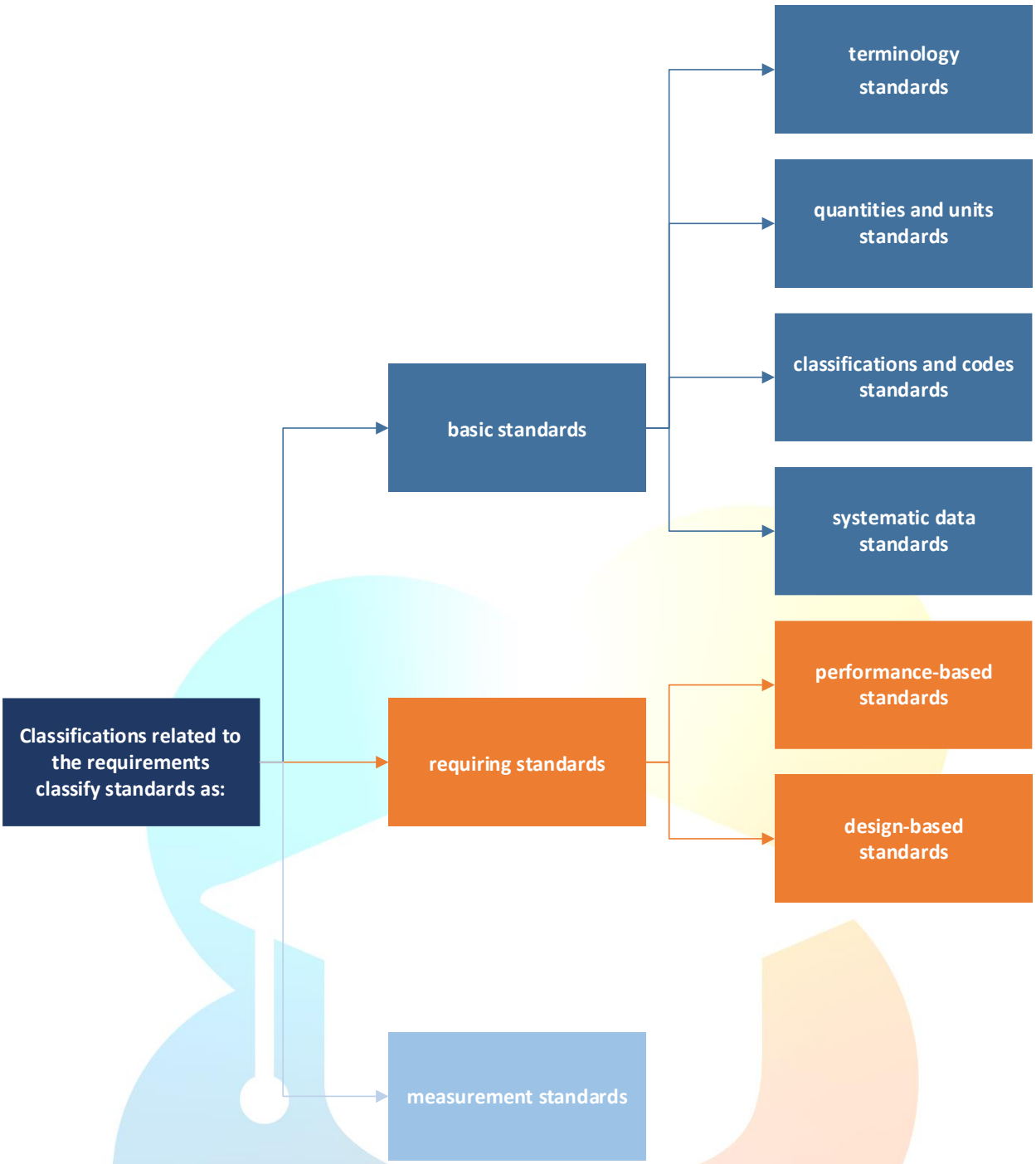

Fig. 2. Classifications related to the requirements

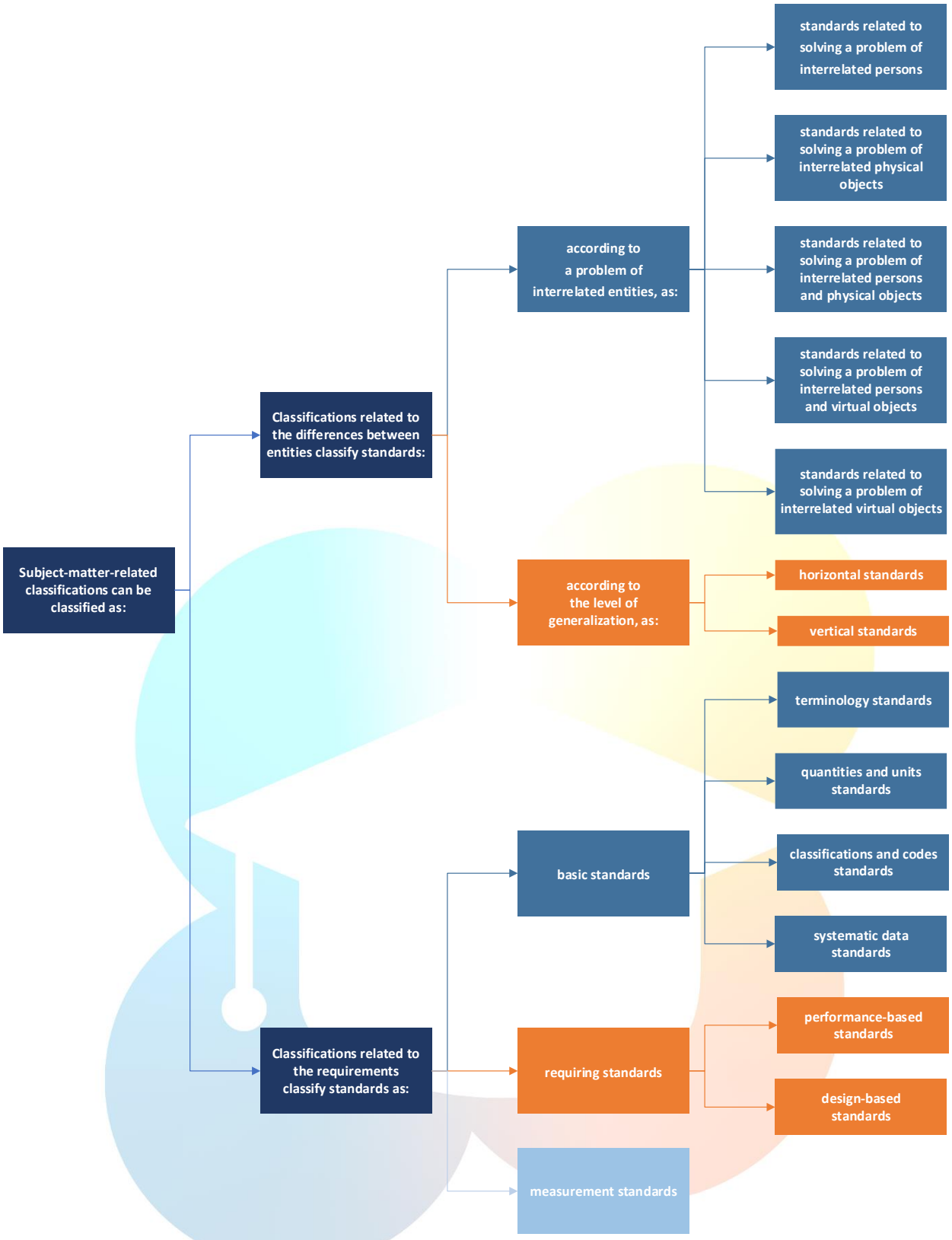

Fig. 3. Subject-matter-related classifications

3 CLASSIFICATIONS RELATED TO STANDARDS DEVELOPMENT

Classifications related to standards development can be classified as: [11]

- classifications related to actors that are interested or involved,
- classifications related to organisations that set the standard(s), and
- classifications related to characteristics of the process of developing standards.

3.1 CLASSIFICATIONS RELATED TO ACTORS THAT ARE INTERESTED OR INVOLVED

Classifications related to actors classify standards as: [12]

- company standards;
- national standards;
- regional standards); and
- international standards.

Classifications related to actors that are interested in the standard or involved in standardisation are made between the international, regional, national, and company level. [13] When it comes to formal standardisation, the distinction is usually made based on the geographic spread of the actors that are able to get involved. [14] These formal standards are used by actors outside the geographic area (e.g. ASTM standards are used in Europe) and actors within the geographic area are not always willing to use these formal standards – (e.g. the A and B paper sizes laid down in international standards are not used in the USA). [15] When it comes to informal standardisation, it might be difficult to use only the distinction based on the geographic spread of the actors involved, since the actors interested in developing informal standards might sometimes be limited to one company. [16]

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[11] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 9.
[12] Spivak, S., & Brenner, C. (2001). Standardisation Essentials: Principles and Practice. CRC Press., p. 3.
[13] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 164.
[14] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 10.
[15] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 10.
[16] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 164.

3.2 CLASSIFICATIONS RELATED TO ORGANISATIONS THAT SET THE STANDARD(S)

Classifications related to organisations classify standards as: [17]

- formal (de jure) standards;
- informal (de facto) standards; and
- standards developed by the government.

Formal organisations for standardisation or Standards Development Organisations (SDOs) are organisations that develop and maintain standards. [18] All formal organisations for standardisation can be categorized as international, regional, and national organisations. Formal organisations for standardisation develop formal (de jure) standards. Informal organisations for standardisation are professional and industrial associations, business associations, consortia, and fora that develop informal (de-facto) standards. De facto standards are standards developed outside of formal organisations for standardisation and the government.

3.3 CLASSIFICATIONS RELATED TO THE CHARACTERISTICS OF THE PROCESS OF DEVELOPING STANDARDS

Classifications related to characteristics of the process of developing standards, classify standards as: [19]

- based on when the standard(s) are made, standards can be classified as anticipatory (prospective), concurrent (participatory), and retrospective (responsive) standards;
- based on the openness of the process of developing standards, standards can be classified as open and closed standards; as suggested by Stuurman, when it comes to open standards all interested parties have been welcome to participate and contrary when it comes to closed standards the participation has usually been restricted; [20] and
- based on how the decision(s) are made, standards can be classified as consensus-based standards and non-consensus-based standards; for example, most formal organisations for standardisation develop voluntary standards based on consensus.

[17] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 9.

[18] Folmer, E., & Verhoosel, J. (2011). State of the Art on Semantic IS Standardisation, Interoperability & Quality. In *Quality*.

[19] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 11.

[20] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.

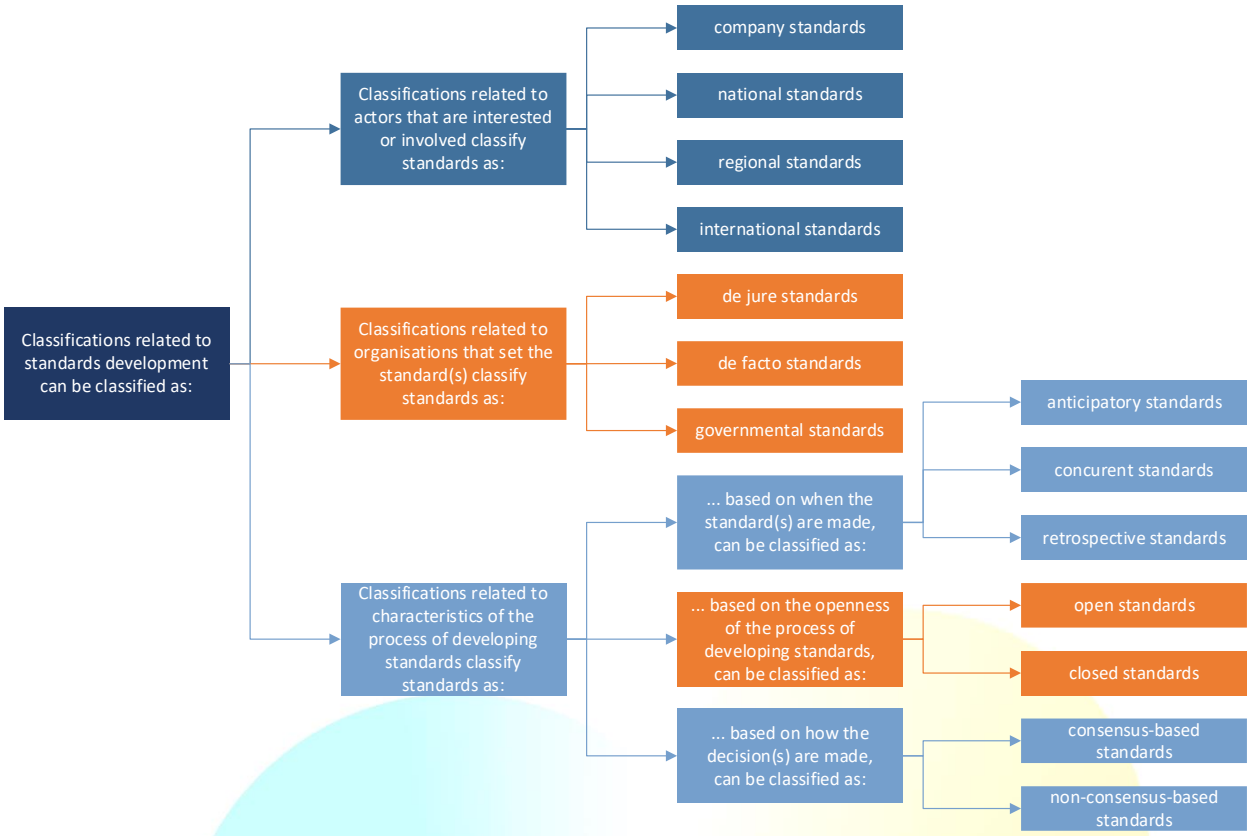

Fig. 4. Classifications related to standards development

4 CLASSIFICATIONS RELATED TO STANDARDS USE

Classifications related to standards use can be classified as: [21]

- classifications related to the business sector where the standard is to be applied;
- classifications related to business models;
- classifications related to the extent of the availability of the standard;
- classifications related to the degree of the obligation of the standard; and
- classifications related to the types of economic problems they resolve.

[21] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 14.

4.1 CLASSIFICATIONS RELATED TO THE BUSINESS SECTOR WHERE THE STANDARD IS TO BE APPLIED

Classifications related to the business sector where the standard is to be applied classify standards as ''engineering, transport, housing and building, agriculture, forestry, textiles, chemicals, commerce, science, and education''. [22] As suggested by de Vries, IT might be added to this list and classifications developed by the Standard Industrial Classification (SIC). [23]

Additionally, standards can be classified as **generic standards** and **sectoral standards**. Generic standards are meant to be used by different organisations, regardless of their size, activity, or sector, while sectoral standards are meant to be used by organisations from the same branch or sector. The motives for the development of standards can be different and the dominant party in the development of standards can choose a solution to a matching problem that suits its needs. For example, various actors from a specific brunch or sector may strive to develop a specific standard that solves their specific problem, while suppliers may strive to develop a generic standard that would enable them access to a larger market.

4.2 CLASSIFICATIONS RELATED TO BUSINESS MODELS

Classifications related to business models classify standards as: [24]

- **regulatory standards** developed by a governmental agency and are obligatory;
- **business/marketing standards** aimed at assisting organisations to achieve some business/marketing advantage or avoid business/marketing disadvantage; and
- **operational standards** aimed at assisting the organisation's day-to-day operations.

The same standard can even be classified differently, considering the party using them. [25] ''A standard that sets requirements for a software module sold by company A may also be applied by company B that integrates this module in its IT system. For company A, the entity is a product and for company B, it is a part of a larger system used for supporting its business processes''. [26]

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[22] Verman, L. C. (1973). Standardisation, a new discipline. Archon Books.
[23] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 16.
[24] Cargill, C. F. (1990). Justifying the need for a standards program. Standards Management-a handbook for profits. New York: American National Standards Institute (ANSI), pp. 1-18.
[25] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 17.
[26] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 18.

4.3 CLASSIFICATIONS RELATED TO THE EXTENT OF THE AVAILABILITY OF THE STANDARD

Classifications related to the extent of the availability of the standard classify standards as: [27]

- **non-public standards** available only to the ones involved in their development and **public standards**, available to all parties for which they are meant;
- **licensed standards** available only to the ones with the licenses and **non-licensed standards** available to all parties for which they are meant.

For example, many standards-setting organisations offer standards freely via their website (e.g. standards developed by the ITU-T are publicly available and can be accessed freely) while some offer standards for a fee (e.g. most international, regional, and national SDOs).

4.4 CLASSIFICATIONS RELATED TO THE DEGREE OF THE OBLIGATION OF THE STANDARD

Classifications related to the degree of the obligation of the standard classify standards as: [28]

- **voluntary standards**, and
- **regulatory standards**.

Standards can sometimes be legally enforced due to market conditions, contracts, and laws. [29] The difference between voluntary and legally enforced standards can cause confusion, considering that the standard can be voluntary for one party and obligatory for the other. ''Company A may use the capability maturity model on software quality assurance as a benchmark in its quality management policy, whereas company B may be forced by its customers to meet the capability maturity model''. [30]

Additionally, the organisation can contractually oblige its supplier to apply a certain standard. From the legal aspect, the obligatory use of the standard is achieved by specifying or referring to the standard as a whole or referring to the parts of the standard in the law. Legislators decide whether the use of the standard within a technical regulation will be obligatory or voluntary. If the legislator defines by regulation

[27] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.
[28] Spivak, S., & Brenner, C. (2001). Standardisation Essentials: Principles and Practice. CRC Press., p. 5.
[29] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 18.
[30] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, pp. 18.

that the use of the standard will be obligatory, it means that the solution defined in the specific standard will be applied as the only solution - to meet the requirements of the regulation, the standard must be applied. If the legislator defines by regulation that the use of the standard will be voluntary, it means that the solution defined in the specific standard will be applied as one of the solutions - to meet the requirements of the regulation, the standard may or may not be applied. Voluntary standards are also known as standards that are developed in a process in which the participation of the actors who develop the standard is completely voluntary.

4.5 CLASSIFICATIONS RELATED TO THE TYPES OF ECONOMIC PROBLEMS THEY RESOLVE

Classifications related to the types of economic problems they resolve classify standards as: [31]

- **compatibility standards** enable the fitting of interrelated entities to one another so they may function together [32]; some of the first examples of standards from this group have been developed to be used by the railway as its success was mainly based on the establishment of networks; several IT standards belong to this group;
- **minimum quality/safety standards** considering that with the development of markets and technologies, information asymmetry emerged as the phenomenon that producers have much more information about the product than customers [33], customers can sometimes face a wide variety of different products on the market and have difficulties distinguishing high-quality from low-quality before buying. As shown by Akerlof, this may lead to a situation in which low-quality sellers will eventually drive high-quality sellers out of the market [34]; this problem can be solved by using minimum quality/safety standards that define the minimum requirements;
- **variety-reducing standards** ''limit the production of a certain product to a certain range of characteristics, such as size, quality, and some technical specifications'' [35], enabling mass production, consequently cutting costs of products, enabling more efficient inventory management, and having specific contributions; an example of these standards are standards giving requirements for screws and transport pallets; and

[31] David, P. (1987). Some new standards for the economics of standardisation in the information age. In M. Waterson, P. Dasgupta, & P. Stoneman (Eds.), *Economic Policy and Technological Performance.* (Vol. 98, Issue 392). https://doi.org/10.2307/2233926, pp. 857.

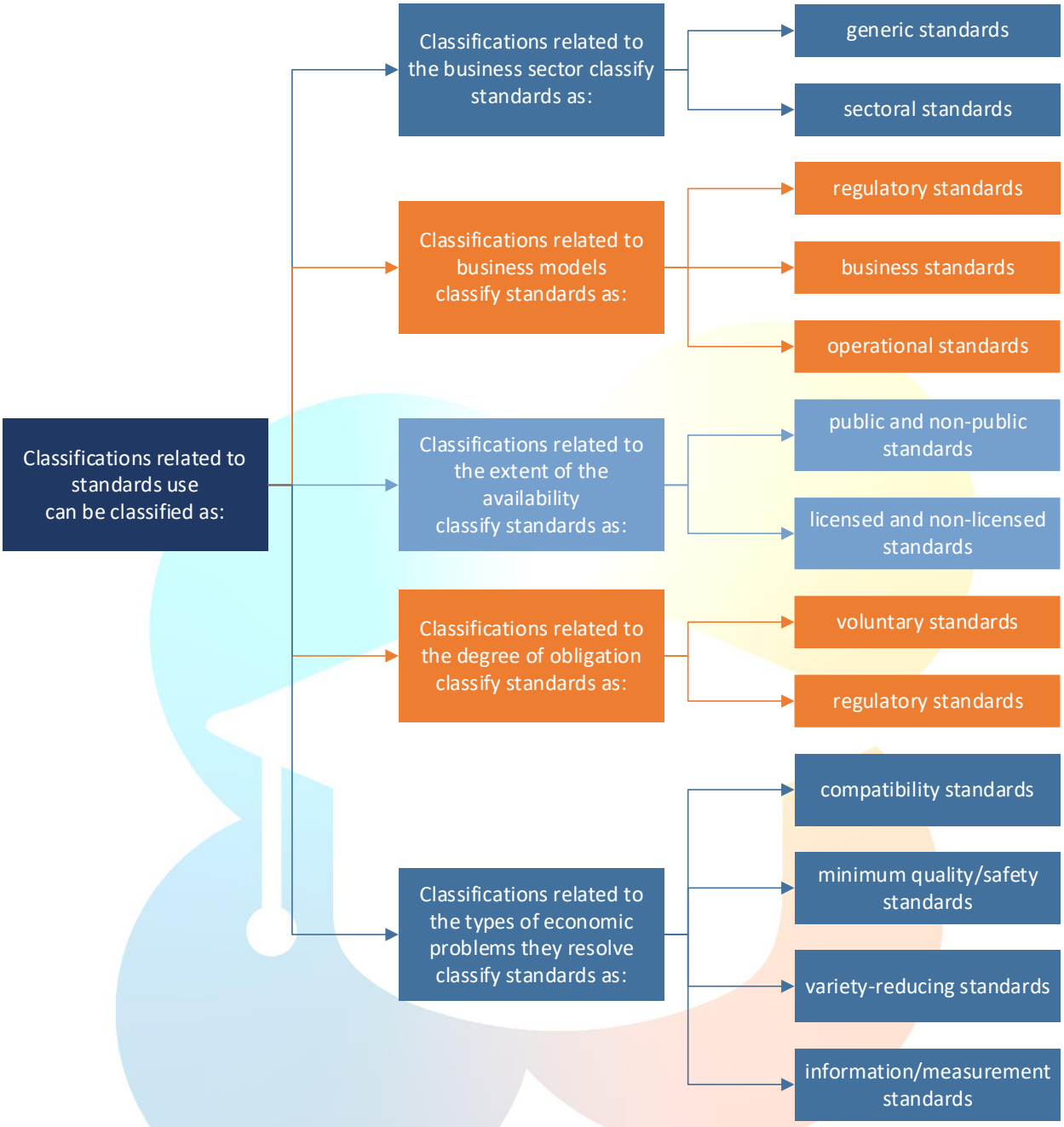
[32] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384

[33] Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*. https://doi.org/10.2307/1879431

[34] Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*. https://doi.org/10.2307/1879431

[35] Pham, T. H. (2006). Economic Aspects of Standardisation. In W. Hesser, Feilzer, & H. De Vries (Eds.), *Standardisation in Companies and Markets*. Helmut Schmidt University, Hamburg, pp. 77-123.

- **information/measurement standards** are a hybrid of the above three categories [36]; an example of these standards are standards that define the marking and grading of tires/marking and grading of petrol (e.g. four-star, unleaded & super-unleaded). [37]



[36] Pham, T. H. (2006). Economic Aspects of Standardisation. In W. Hesser, Feilzer, & H. De Vries (Eds.), *Standardisation in Companies and Markets*. Helmut Schmidt University, Hamburg, pp. 77-123.

[37] Pham, T. H. (2006). Economic Aspects of Standardisation. In W. Hesser, Feilzer, & H. De Vries (Eds.), *Standardisation in Companies and Markets*. Helmut Schmidt University, Hamburg, pp. 77-123.

Fig. 5. Classifications related to standards use

Note: Some authors argued that compatibility standards and minimum quality/safety standards can also be classified as requiring standards. [38] This can be explained by the fact that compatibility standards are always descriptive and minimum quality/safety standards can be classified either as performance-based standards or design-based standards. [39] Similarly, information/measurement standards can be classified as requiring standards, and even standards that describe a solution for measuring (e.g. measurement standards). [40]

[38] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 163.
[39] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 163.
[40] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384, pp. 163.

SUMMARY

To date, the classification of standards has constantly been the subject of many discussions in the standardisation community. Although several authors have approached the problem of the classification of standards from various aspects, there are still several shortcomings that may be seen as inconsistencies and incompleteness of the proposed classifications. Accordingly, it is important to understand that there is no universal agreement about the classification of standards and there are various ways in which standards can be classified:

1. THE NEED FOR CLASSIFICATION OF STANDARDS

2. SUBJECT-MATTER-RELATED CLASSIFICATION

2.1. Classifications related to the differences between entities

- horizontal standards and vertical standards;

2.2. Classifications related to the requirements

- basic standards;
  - terminology standards;
  - quantities and units standards;
  - classifications and codes standards;
  - systematic data standards;
- requiring standards;
  - performance-based standards;
  - design-based standards;
- measurement standards;

3. CLASSIFICATIONS RELATED TO STANDARDS DEVELOPMENT

3.1. Classifications related to actors that are interested or involved

- company standards;
- national standards;
- regional standards;
- international standards;

3.2. Classifications related to organisations that set the standard(s)

- formal (de jure) standards;
- informal (de facto) standards;
- standards developed by the government;

3.3. Classifications related to the characteristics of the process of developing standards

- anticipatory, concurrent, and retrospective standards;
- open and closed standards;
- consensus-based and non-consensus-based standards;

4. CLASSIFICATIONS RELATED TO STANDARDS USE

4.1. Classifications related to the business sector where the standard is to be applied

- generic and sectoral standards;

4.2. Classifications related to business models

- regulatory standards;
- business/marketing standards;
- operational standards;

4.3. Classifications related to the extent of the availability of the standard

- non-public standards and public standards;
- non-licensed standards and licensed standards;

4.4. Classifications related to the degree of the obligation of the standard

- voluntary standards;
- regulatory standards;

4.5. Classifications related to the types of economic problems they resolve

- compatibility standards;
- minimum quality/safety standards;
- variety-reducing standards;
- information/measurement standards;

GLOSSARY

basic standards

give structured descriptions (aspects of) interrelated entities to encourage communication about these entities and the use among other standards: [41]

- terminology standards;
- quantities and units standards;
- classifications and codes standards;
- systematic data standards;

business/marketing standards

aimed at assisting organisations to achieve some business/marketing advantage or avoid business/marketing disadvantage [42]

classic standards

give general descriptions [43]

closed standards

where participation has been restricted [44]

common standards

developed by meeting the common interest(s) [45]

company standards

[41] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 6.
[42] Cargill, C. F. (1990). Justifying the need for a standards program. Standards Management - A handbook for profits.
[43] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384
[44] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.
[45] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.

developed by a company and may have a form of: [46]

- a reference to external standards officially adopted by the company;
- a modification of an external standard;
- a subset of an external standard;
- a standard based on an external document; and
- a self-written standard.

compatibility standards

enable the fitting of interrelated entities to one another so they may function together [47]

consortium standards

developed by an alliance of companies or consortium [48]

de facto standards

developed outside of formal organisations for standardisation and the government

de jure standards

developed by formal organisations for standardisation

design-based standards

describe the solution(s) to a matching problem [49]

[46] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.
[47] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384
[48] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.
[49] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

functional standards

give a selection of the options offered in classic standards [50]

generic standards

meant to be used by organisations regardless of their size, activity, or sector

governmental standards

developed by a governmental agency [51]

horizontal standards

set general requirements for a collection of different entities [52]

information/measurement standards

a hybrid of compatibility, minimum quality/safety, and the variety-reducing standards [53]

licensed standards

available only to the ones with the licenses [54]

management system standards

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[50] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384

[51] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[52] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[53] Pham, T. H. (2006). Economic Aspects of Standardisation. In W. Hesser, Feilzer, & H. De Vries (Eds.), *Standardisation in Companies and Markets*. Helmut Schmidt University, Hamburg, pp. 77-123.

[54] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

aim at assisting organisations to achieve the requirements that are specified in the product and process standard(s) [55]

measurement standards

describe methods to be used to check if requiring-standards criteria have been met [56]

minimum quality/safety standards

set minimum requirements of products, services, processes, and management systems [57]

non-licensed standards

available to all parties for which they are meant [58]

non-public standards

available only to the ones involved in their development [59]

one-sided standards

developed by only one dominant organisation [60]

open standards

where all interested parties are welcome to participate [61]

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[55] Stroyan, J., & Brown, N. (2012). Using Standards to Support Growth, Competitiveness and Innovation. In *Guidebook Series: How to Support SME Policy from Structural Funds.* (Issue October). https://doi.org/10.2769/42198

[56] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[57] Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*. https://doi.org/10.2307/1879431

[58] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[59] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.

[60] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.

operational standards

aimed at assisting the organisation's day-to-day operations [62]

performance-based standards

set performance criteria for the solution(s) to a matching problem [63]

process standards

cover conditions under which products are being produced [64]

product standards

cover different characteristics of products mostly considering their quality, safety, and even their interoperability with other related products [65]

public standards

available to all parties for which they are meant [66]

regulatory standards

developed by a governmental agency and are obligatory [67]

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[61] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.
[62] Cargill, C. F. (1990). Justifying the need for a standards program. Standards Management-a handbook for profits. New York: American National Standards Institute (ANSI), pp. 1-18.
[63] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.
[64] Stroyan, J., & Brown, N. (2012). Using Standards to Support Growth, Competitiveness and Innovation. In *Guidebook Series: How to Support SME Policy from Structural Funds.* (October), pp. 14. https://doi.org/10.2769/42198
[65] Stroyan, J., & Brown, N. (2012). Using Standards to Support Growth, Competitiveness and Innovation. In *Guidebook Series: How to Support SME Policy from Structural Funds.* (October), pp. 14. https://doi.org/10.2769/42198
[66] Stuurman, K. (1995). Technische normen en het rech. *Reeks Informatica En Recht*, *17*, pp. 584.
[67] Cargill, C. F. (1990). Justifying the need for a standards program. Standards Management-a handbook for profits. New York: American National Standards Institute (ANSI), pp. 1-18.

requiring standards

set requirements for entities or relations between entities [68]

sectoral standards

developed by organisations from the same brunch or sector [69]

service standards

cover different characteristics of services aimed at ensuring a bare minimum of quality and safety during the provision of services, and specifying all the rights and responsibilities of all parties involved in the provision of services [70]

standards for testing

give a technical procedure for performing a specific test [71]

variety-reducing standards

''limit the production of a certain product to a certain range of characteristics, such as size, quality, and some technical specifications'', enabling mass production, consequently cutting costs of products, enabling more efficient inventory management & specific contributions [72]

vertical standards

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[68] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[69] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research. Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[70] Stroyan, J., & Brown, N. (2012). Using Standards to Support Growth, Competitiveness and Innovation. In *Guidebook Series: How to Support SME Policy from Structural Funds.* (Issue October). https://doi.org/10.2769/42198

[71] de Vries, H. J. (1999). Standardisation: A Business Approach to the Role of National Standardisation Organisations. Springer Science+Business Media, LLC. https://www.springer.com/gp/book/9780792386384

[72] Pham, T. H. (2006). Economic Aspects of Standardisation. In W. Hesser, Feilzer, & H. De Vries (Eds.), *Standardisation in Companies and Markets*. Helmut Schmidt University, Hamburg, pp. 77-123.

set several requirements for one kind of entity [73]

voluntary standards

developed by formal organisations for standardisation [74]

[73] de Vries, H. J. (2006). IT Standards Typology. In K. Jakobs (Ed.), Advanced Topics in Information Technology Standards and Standardisation Research . Idea Group Publishing. https://www.igi-global.com/gateway/chapter/4654#pnlRecommendationForm, p. 4.

[74] Cargill, C. F. (1990). Justifying the need for a standards program. Standards Management-a handbook for profits. New York: American National Standards Institute (ANSI), pp. 1-18.

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