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First report on CEN existing standards

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Network for Using BIM to Increase the Energy Performance
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1. Deliverable details

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2. Brief description

This deliverable is part of WP5, that will be the basis for the development of standardized schemas for BIM energy performance competences as well as for the definition of recommended practices for PA, owners and facility managers of buildings.

In order to capitalize at European level, the work done in the project will be proposed at CEN TC 442 dealing with BIM in order to propose an EN standard for the qualification of BIM professional experts in energy performance of buildings.

This document constitutes the basis for the proposal of qualification and certification work, and summarizes the existing standards in the European standardization landscape.

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3. Why standardization?

Standards are the industrial common technical language. Standardization is the implementation of standard quality criteria for products, processes and procedures. It aims at elaborating a series of technical specifications (standards) to be commonly used on a voluntary basis.

Broadly speaking, standardization facilitates processes and seeks to benefit citizens based on the reality of a globalized society. An example of the need to establish certain common standards for the entire international community could be that referring to the standardization of the systems through which plugs have to work; the mere possibility that each country would opt for a particular specific system would lead to huge losses of money, insecurity, and all kinds of dysfunctions. Another simple and recognizable example is the use of credit cards in almost everywhere in the world.

A specific definition of what a standard is would be "the technical specification of repetitive or continuous application whose observance is not mandatory, established with the participation of all interested parties, approved by a recognized body, nationally or internationally, for its normative activity".

These standards are developed by Standardization Agencies, through different Technical Standard Committees. These committees are composed of a balanced representation of all those entities that have an interest in the standardization (normalization) of a particular topic, thus guaranteeing transparency, openness and consensus.

The process of developing a standard integrates a series of stages that allow to ensure that the final document is the result of consensus, and that any person, even if s/he does not belong to the working group that produces it, can express her/his opinions or comments.

In this context, it must be stressed the relevance of national and international standardization and certification bodies, as the entities that accredit that these homologation standards agreed are faithfully met.

Applying standards in the industry implies increasing the competitive capacity, which, in a globalized economy, is a crucial requirement. There are numerous benefits that may be acquired through adoption of standards, among others:

- Information. The first contact with standardization usually occurs by gathering data about how to manage the processes derived from certain productive activities or services: requirements, legal aspects, etc. In short, access to information facilitates the planning of an organization.

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- Legal responsibility. In the interactions of organizations, trust and confidence is essential to optimize their relationships. In modern societies, the most effective way to ensure trust is channeled through laws. Therefore, legal responsibility is another guarantee, derived from standardization and trust, which may increase the volume of business.

- Access to and influence in the markets. The fulfillment of the standardization criteria will work, roughly, as a kind of passport for products and services. Being present in the debates that generate the normalizing consensus favors an influence on the final decision-making that can yield great benefits.

- Help with legislation. Standardization contributes to generating greater legal security, both in the Public Administration and in the private sphere.

- Favor technical progress, economic development and quality of life. It aims to establish common dispositions to face real or potential common problems.

- Guarantee that products and services are safe, reliable and of good quality. For business, standards are strategic tools that reduce costs by minimizing waste and errors and increasing productivity. They help companies to access new markets, level the playing field for developing countries and facilitate free and fair global trade.

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4. International standardization

The International Organization for Standardization (ISO) is an international standard-setting body founded in 1947 as an independent, non-governmental organization. It promotes worldwide proprietary, industrial and commercial standards.

ISO is composed of representatives from various national standards organizations from more than 150 countries, being part of 781 technical bodies in charge of standards development.

ISO has published 21976 international standards and related documents, covering almost every productive sector and almost all aspects of technology and manufacturing. An international standard provides rules, guidelines or characteristics for activities or for their results, aimed at achieving the optimum degree of order in a given context.

The key principles in standard development are the following[1]:

1. ISO standards respond to a need in the market. ISO does not decide when to develop a new standard, but responds to a request from industry or other stakeholders such as consumer groups. Typically, an industry sector or group communicates the need for a standard to its national member who then contacts ISO.
2. ISO standards are based on global expert opinion. ISO standards are developed by groups of experts from all over the world that are part of larger groups called Technical Committees (the list of the ISO Technical Committees is available here). These experts negotiate all aspects of the standard, including its scope, key definitions and content. Details can be found in the list of technical committees.
3. ISO standards are developed through a multi-stakeholder process. The TCs are made up of experts from the relevant industry, but also from consumer associations, academia, NGOs and governments.
4. ISO standards are based on a consensus. Developing ISO standards is a consensus-based approach and comments from all stakeholders are taken into account.

The image below shows the ISO Standards development process:

[1] https://www.iso.org/developing-standards.html

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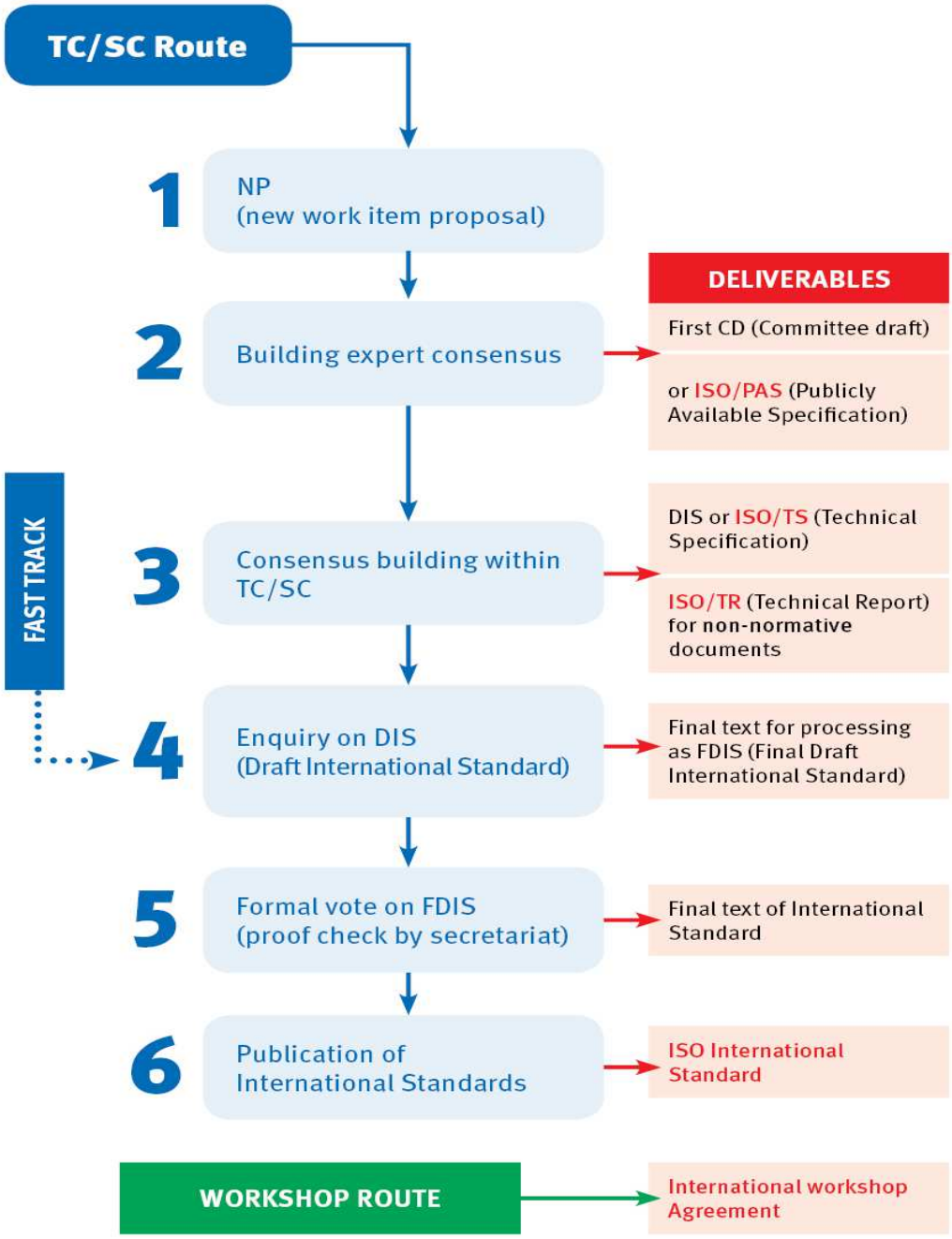

Apart from the well-known international standards, ISO produces other deliverables (as shown in the previous image):

***Technical Specifications*.** They address work still under technical development, or where it is believed that there will be a future *-but not immediate-* possibility of

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agreement on an international standard. A technical specification is published for immediate use, but it also provides a means to obtain feedback. The aim is that it will eventually be transformed and re-published as an international standard.

Technical Reports. They contain information of a different kind from that of the international standards and the technical specifications. It may include data obtained from a survey, for example, or from an informative report, or information of the perceived state-of-the-art.

Publicly Available Specifications. They are published in order to respond to an urgent market need, representing either the consensus of the experts within a working group, or a consensus in an organization external to ISO. As with technical specifications, these are published for immediate use and also serve as a means to obtain feedback for an eventual transformation into an international standard. Publicly Available Specifications have a maximum life of six years, after which they can be transformed into an international standard or withdrawn.

International Workshop Agreements. They are documents developed outside the normal ISO committee system to enable market players to negotiate in an "open workshop" environment. International Workshop Agreements are typically administratively supported by a member body. The published agreement includes an indication of the participating organizations involved in its development. An International Workshop Agreement has a maximum lifespan of six years, after which it can be either transformed into another ISO deliverable or is automatically withdrawn.

Guides. They help readers understand more about the main areas where standards add value. Some guides talk about how, and why, ISO standards can make it work better, safer, and more efficiently.

ISO works to ensure that standards are developed by the stakeholders for the stakeholders, so that market needs can be effectively met. There are some documents that provide guidance on stakeholder engagement processes:

- Guidance for national standards bodies
- Guidance for ISO liaison organizations
- Additional guidance from the ISO TMB
- Engaging stakeholders for ISO national standards bodies
- Engaging consumers in standards development

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ISO and Building Information Modelling (BIM)

At the international scope, the work for standardization of the BIM model are responsibility of the subcommittee ISO/TC59/SC13, *Organization of information about construction works*. The main objective of this subcommittee is the standardization of the BIM model to allow the exchange of information of all kinds, throughout the whole lifespan of the project, and among all the entities that participate in the process.

The standards under the responsibility of ISO/TC59/SC13 are the following[2]:

ISO/TS 12911:2012
Framework for building information modelling (BIM) guidance

ISO 16757-1:2015
Data structures for electronic product catalogues for building services. Part 1: Concepts, architecture and model

ISO 12006-2:2015
Building construction. Organization of information about construction works. Part 2: Framework for classification

ISO 12006-3:2007
Building construction. Organization of information about construction works. Part 3: Framework for object-oriented information

ISO 16354:2013
Guidelines for knowledge libraries and object libraries

ISO 22263:2008
Organization of information about construction works. Framework for management of project information

ISO 29481-1:2016
Building information models. Information delivery manual. Part 1: Methodology and format

ISO 29481-2:2012
Building information models. Information delivery manual. Part 2: Interaction framework

[2] http://www.aenor.es/DescargasWeb/normas/informe-bim.pdf

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Source: AENOR

However, one of the main standards on BIM (ISO 16739:2013, *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries*) has not been developed by ISO/TC 59/SC13, but by ISO/TC 184/SC4. This is being corrected through the revision of the document made by the Joint Working Group ISO/TC 59/SC 13/JWG 12, which integrates both groups.

This ISO 16739:2013 specifies a conceptual data schema and an exchange file format for BIM data. The conceptual schema is defined in EXPRESS data specification language. The standard exchange file format for exchanging and sharing data according to the conceptual schema is using the Clear text encoding of the exchange structure. Alternative exchange file formats can be used if they conform to the conceptual schema.

ISO 16739:2013 represents an open international standard for BIM data that is exchanged and shared among software applications used by the various participants in a building construction or facility management project. It consists of the data schema, represented as an EXPRESS schema specification, and reference data, represented as definitions of property and quantity names and descriptions.

A subset of the data schema and referenced data is referred to as a model view definition. A particular model view definition is defined to support one or many recognized workflows in the building construction and facility management industry sector. Each workflow identifies data exchange requirements for software applications. Conforming software applications need to identity the model view definition they conform to.

The following are within the scope of ISO 16739:2013:

- BIM exchange format definitions that are required during the life cycle phases of buildings: demonstrating the need; conception of need; outline feasibility; substantive feasibility study and outline financial authority; outline conceptual design; full conceptual design; coordinated design; procurement and full financial authority; production information; construction; operation and maintenance;
- BIM exchange format definitions that are required by the various disciplines involved within the life cycle phases: architecture; building service; structural engineering; procurement; construction planning; facility management; project management; client requirement management; building authority for permits and approval;
- BIM exchange format definitions including: project structure; physical components; spatial components; analysis items; processes; resources; controls; actors; context definition.

The following are outside the scope of ISO 16739:2013:

- Exchange format definitions outside of the domain of construction and facility maintenance;
- Project structure and component breakdown structures outside of building engineering;
- Behavioral aspects of components and other information items.

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ISO 16739:2013 will be replaced by ISO/DIS 16739-1 *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries -- Part 1: Data schema using EXPRESS schema definitions* [Under development].

ISO 16739-1:2017 of IFC consists of the data schemas, represented as an EXPRESS schema and an XML schema, and reference data, represented as definitions of property and quantity names, and formal and informative descriptions.

A subset of the data schema and referenced data is referred to as a Model View Definition (MVD). A particular MVD is defined to support one or many recognized workflows in the construction and facility management industry sector. Each workflow identifies data exchange requirements for software applications. Conforming software applications need to identity the model view definition they conform to.

Besides, the Joint Working Group ISO/TC 59/SC 13/JWG 12 elaborates a report about all the international standards on BIM and their interaction, urging ISO/TC59/SC13 to carry out a general revision of its catalogue.

ISO/TC59/SC13 is closely coordinated both with CEN/TC 442 and with BuildingSmart International. Furthermore, ISO/TC59/SC13 keep alliances with all the ISO related technical committees.

Other ISO Works related to BIM

As BIM is a transversal methodology, it is quite normal that also other ISO technical bodies are developing projects directly or indirectly related to BIM. Some examples:

- ISO/TC 59/SC 3, Functional/user requirements and performance in building construction. ISO Standard 11863:2011, Buildings and building-related facilities. Functional and user requirements and performance. Tools for assessment and comparison.
- ISO/TC 59/SC 14, Design life. Norma ISO 15686-4:2014, Building Construction. Service Life Planning. Part 4: Service Life Planning using Building Information.
- ISO/TC 10/SC 1, Basic conventions. ISO Standard 29845:2011, Technical product documentation. Document types.
- ISO/TC 10/SC 8 Construction documentation. Technical report ISO/TR 16310:2014, Symbol libraries for construction and facilities management.
- ISO/TC 184/SC 4, Industrial data. Technical Specification ISO/TS 15926-11:2015, Industrial automation systems and integration. Integration of life-cycle data for process plants including oil and gas production facilities. Part 11: Methodology for simplified industrial usage of reference data.
- ISO/TC 204, intelligent transport systems. ISO Standard 17438-1:2016, Intelligent transport systems. Indoor navigation for personal and vehicle ITS station. Part 1: General information and use case definition.
- ISO/TC 211, Geographic information/Geomatics. Project ISO/NP 19166, Geographic information. BIM to GIS conceptual mapping (B2GM).

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5. National standardization bodies

Standards usually start at the national level. Most countries have their own national standards-making bodies, and most of these are members of ISO.

The national standards bodies may also join to create other smaller regional standards. For example, national standards bodies in Europe are also members of the European Committee for Standardization (CEN) as well as members of ISO. In Europe, standards are used to support a pan-European legislation under the so-called 'New Approach'3.

Standards are mandatory when referenced in specific EU Directives, but otherwise the decision on their use remains voluntary.

According to the World Trade Organization (WTO) rules, national governments are required to base their regulations on standards produced by organizations like ISO as much as possible. Partly because of these rules, and also because of the general globalization of trade, national and regional standards bodies are either adopting or otherwise using International Standards, where possible.

a. Italy

UNI (Ente Nazionale Italiano di Unificazione) is a private no-profit association admitted by the Italian Government and the European Union which elaborates and publishes technical regulations in each industry from around 100 years. UNI represents Italy in the European Standardization Body (CEN) and Global Standardization Body (ISO).

The goals of UNI are:

- to promote and harmonize regulations concerning the Italian Single Market
- to sustain and transpose the Italian production methods with standards and specification which can increase the value of the products.

The regulation activity is made by a multilevel structure organized in 1.100 Technical Offices and by 7 independent external organizations (Federal Body) under the supervision of Central Technical Committee.

The UNI regulations for the digitalization of the construction industry at National level are:

[3] http://www.newapproach.org/

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UNI 11337-1:2017

- structure of information vehicles
- information structure of processes
- information structure of products

UNI 11337-2

- Identification, classificiation and denomination of buildings and engineering works in common way
- Identification, classificiation and denomination of services, supply, works in common way
- Identification, classificiation and denomination of human resources, products and equipments in common way

UNI/TS 11337-3:2015

- qualitative and measurable description of data and technical information for Technicians
- quantitative and measurable description of data and technical information for Technicians

UNI 11337-4:2017

- identificate goals in each phase of the building life cycle
- define a common level scale for the informatic development of objectives
- define a common level scale for working stages

UNI 11337-5:2017

- Define roles, rules and working flows for the production, management and transmission of information and their linking to Building Information Modelling

UNI 11337-6

- Digital management of Building Information Models
- Guidelines for the Information Specifications

UNI 11337-7

- Requirements, knowledge, skills and competences for figures involved in Building Information Modeling (work in progress)

UNI 11337-8

- Integrated processes of information management and decision-making (work in progress)

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b. Slovakia

In Slovakia, Národný úrad pre normalizáciu, metrológiu a testovanie (Slovak Office of Standards, Metrology and Testing, www.unms.sk) is responsible for transposing CEN and ISO standards. The mission of the Slovak Office of Standards, Metrology and Testing which is a governmental institution with a cross-industry competence, is creation and development of the quality infrastructure tools.

Its primary goal is to create a competitive and effective environment in the Slovak Republic and to support the protection of consumer – each citizen.

In European meaning, the quality infrastructure is understood as standardization, metrology, conformity assessment, accreditation and market control, in which activities are focused on the enforcement of directives, particularly of the New Approach.

- Coordinates and fulfils tasks issuing from conclusions of the Ministerial Council for the Lisbon Strategy and the European Union Affairs Commission;
- Through the Section Coordination Group coordinates the decision-making process related to European Union affairs and ensures the participation of the Office in the European Union Affairs Commission;
- Cooperates with the European Union authorities (particularly with the European Commission and European Union Council) in areas related to the free movement of goods as one of the basic freedoms of single market;
- Cooperates at finding solutions related to institutional implementation of Acquis Communautaire within the competence of the Office, particularly in the quality infrastructure;
- Works out and coordinates the preparation of the Slovak positions for meetings of committees, working groups and other European Commission structures as well as European Union Council and other European Union authorities and international organizations; within the framework of the Office ensures and coordinates the participation at such meetings as well as the fulfilment of tasks and information communication arising from those meetings;
- Ensures providing, co-ordination and monitoring of projects funded from the resources of pre-accession, structural and other funds as well as the funds assigned for developmental aid created by the Slovak Republic or international bodies;
- Creates developmental projects related to utilization of financial resources provided by pre-accession tools of the European Union as well as public resource sand, structural tools of the European Union; provides assessment and analyses of preparatory and design documentation of the projects covered from European funds destined for the needs of the Office or the organizations within the competence of the Office;

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- Administers the contracts within the phase of accomplishment of the projects covered from European funds destined for the needs of the Office or the organizations within the competence of the Office;
- Cooperates on the projects for state administration trainings in the field of European affairs;
- Prepares statements and coordinates working out of positions related to documents of the EC Directorate General for Enterprise and Industry, and the EC Directorate General for Enlargement;
- Provides guidance and coordination of the information exchange process in the field of technical regulations in the Slovak Republic as well as the intermediation of positions to the drafts of mandates for working out technical standards approved by the 98/34/EC Committee and to the objections against statute "harmonized EN" and changes of this statute discussed by the 98/34/EC Committee, including the communication with the European Commission;
- Within the framework of concluded international treaties of the Slovak Republic and on the basis of the European Union regulations informs all involved subjects in accordance with adopted procedures on preparation of technical regulations, conformity assessment procedures and other measures which could possibly create obstacles having impact on the international trade or free movement of goods (notification obligations, multilateral meetings at WTO, UNECE, EC Directorate General for Trade);
- Participates in preparation, working out of drafts of international treaties and takes part in the international meetings on these treaties;
- Provides statements related to legal and other Acts of the Slovak Republic and works out, respectively makes statements on the compatibility clauses and conformity tables to the legal arrangements transposing directives in the field of free movement of goods;
- Participates in the preparation of amendments to the legal acts in the Slovak Republic in the field of technical harmonization;
- Provides information on products within the non-harmonized area;
- Appointed experts ensure fulfilment of tasks related to the administration of selected Directives in the field of free movement of goods;
- Provides activities functioning of the Presidents/s Council for removal of technical barriers to trade;
- Provides transfer and dissemination of the UNECE Working Party on Regulatory Cooperation and Standardization Policies (WP.6) activities to the organizations within the competence of the Office; co-ordinates preparation of related Slovak outputs for the bodies of this working party.

In respect of **BIM**, on 12 June 2017, UNMS established **Technical Committee No 121 on BIM**. The objective of this technical working group will be standardization in the area of semantic information of the building life cycle. TK 121 does not plan to develop standards at national level for BIM, the aim of the standardization office is to take over the outcomes of the standardization

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activities of CEN and ISO. Representatives of the TK121 of UNMS and EU BIM Group are part of the Build Up Skills network in Slovakia (specifically, the ingREeS project).

c. Spain

The Spanish Association for Standardization and Certification was founded in 1986, coinciding with Spain's accession to the European Economic Community. The opening of borders that this represented was at once a huge opportunity and a challenge for Spanish products.

The first year saw the creation of the first 24 technical standardization committees, mostly as a result of the transfer of IRANOR's technical operations, and a basic body of 7810 standards was established, also inherited from this organization. One year later, the Spanish Association for Standardization and Certification began representing Spain before European bodies (CEN, CENELEC and ETSI) and international organizations (ISO and IEC).

There are currently more than 200 technical standardization committees, on which nearly 6000 experts participate. Their work is internationally recognized, as demonstrated by the fact that increasingly more standards developed in Spain are used as a benchmark for the creation of European and international standards.

In 2017 activities have been divided between two bodies, UNE (Spanish Normalization, a non-profit organization) carrying out standardization and cooperation activities and AENOR, a commercial entity, works in the field of conformity assessment and other related areas, such as training and the sale of publications.

AENOR-UNE is the only standardization body in Spain, and is the only Spanish entity member of CEN, CENELEC, ISO and IEC (International Electrotechnical Commission).

In July 2015, the Spanish Ministry of Infrastructure/Development launched the BIM Commission, aiming at fostering the implementation of the BIM model in Spain. AENOR is one of the bodies required by the Ministry to be part of this commission. This BIM Commission is organized in five working groups:

- GT1 – Strategy
- GT2 – People
- GT3 – Processes
- GT4 – Technology
- GT5 – International

Within GT3 (Processes). AENOR is in charge of Sub-Group 3.4. (*Standardization and normalization*), responsible of informing about the evolution of the BIM standardization works developed at national, European and international levels.

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d. Croatia

The Government of the Republic of Croatia at first entrusted the Ministry of Science and Technology with the tasks in the above mentioned fields. The tasks were then taken over by the newly established Republic Institute for Standardization and Metrology (Narodne novine No. 73 of 31 December 1991) which, under the Law on the Structure and Authority of Ministries and Other Public Authorities (Narodne novine 55/92), changed its name into the State Office for Standardization and Metrology (DZNM) in 1992.

The Croatian Standards Institute is an autonomous non-profit public institution established as the national standards body of the Republic of Croatia with a view to accomplishing the following goals of standardization:

- increasing the safety level of products and processes,
- protecting human health and lives and environmental protection,
- promoting the quality of products, processes and services,
- ensuring the appropriate use of work, materials and energy,
- improving production efficiency,
- controlling variety, ensuring compatibility and interchangeability, and
- removing technical barriers to international trade.

Croatian Standards Institute is a member of:

- International Organisation for Standardization (ISO)
- International Electrotechnical Commission (IEC)
- European Committee for Standardization (CEN)
- European Committee for Electrotechnical Standardization (CENELEC)
- European Telecommunications Standards Institute (ETSI) (status: NSO member)

The Croatian Standards Institute acts as the enquiry point for the *World Trade Organization Agreement on Technical Barriers to Trade (WTO/TBT)* and the contact point for *Codex Alimentarius*.

Technical committees for energy efficiency

- TO 163, Toplinska izolacija (Thermal insulation)

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- TO 536, Vrata, prozori i staklo u graditeljstvu (Doors, windows and glass in construction)
- TO 541, Sustavi grijanja, ventilacije i klimatizacije u građevinama (heating, ventilation and air conditioning systems in buildings)
- TO 551, Gradnja (Construction)
- TO 549, Svjetlo i rasvjeta (Light and lighting)

Technical committees for BIM

- TO 521, Usluge održavanja (Maintenance services)
- TO 551, Gradnja (Construction)

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e. Estonia

The Estonian Centre for Standardization aims at steering and coordinating activities in the areas of standardization, metrology and accreditation in Estonia. It has rights and obligations in overseeing standardisation activities in Estonia.

On the other hand, the Estonian Qualifications Authority (trademark - **Kutsekoda**) as a private legal entity (foundation) was established in August 2001 in order to continue developing the occupational qualifications system launched by the Estonian Chamber of Commerce and Industry in 1997. Kutsekoda was established by the Estonian Chamber of Commerce and Industry, Estonian Employers' Confederation, Ministry of Social Affairs, Estonian Employees' Unions' Confederation (TALO) and the Confederation of Estonian Trade Unions. In addition to the founders of the Kutsekoda, the Supervisory Board of the Kutsekoda includes a representative of the Ministry of Education and Research.

Kutsekoda is developing a support structure for occupational qualifications system in order to increase the competitiveness of Estonian employees and promote the development, assessment, recognition and comparison of their occupational competence.

Main functions of Kutsekoda are:

1. to organize and coordinate the activities of sector skills councils;

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2. to provide counselling and assistance for awarding bodies;
3. to keep the register of occupational qualifications;
4. to organize consultation and training related to the occupational qualifications system;
5. to introduce the Estonian occupational qualifications system on the national and international level by creating conditions for the mutual comparison of occupational qualifications;
6. to organize the development and updating of occupational qualification standards on the basis of decisions made by sector skills council;
7. to organize the work of Europass Centre;
8. to act as a national reference point for vocational qualifications and as a national coordination point for the EQF implementation.

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f. The Netherlands

The current national standardization body in the Netherlands is called NEN, which stands for "Nederlandse Norm", which can be freely translated as 'Dutch Standard'. It originated from the first standardization body in the Netherlands (HCNN) which was founded in 1916 and later, in 1958, changed its name to NEN. Anno 2018, NEN has formulated certain objectives:

- Overseeing the development of national standards in the Netherlands;
- Take account for Dutch participation in the development of European standards;
- Improving the use of standards in the Netherlands;
- Act as the knowledge center for standards.

NEN tries to accomplish these objectives by involving marker parties in the development of the standards. These parties participate for two main reasons. First is to have their day-to-day involved in the development of standards so they are inclusive, informed and credible. Second is because NEN follows the belief of consensus based standards (market will accept the standards, because the participating parties are a good reflection of the market). These standards are indicated as NENxxxxx (where xxxxx represents a standards number). Sometimes there are urgent matters at hand, mostly due to national politics. Instead of a consensus based standard, NEN will then produce an NPR or NTR.

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The NEN standards are in most cases not obliged. However there are exceptions. For example, the construction sector in the Netherlands is obliged to follow the active Building Regulation. This Building Regulation contains requirements to which a building much comply in order to assure safe, healthy, usable, energy efficient buildings. In some cases, for example, the requirements for ventilation, the Building Regulation 'appoints' certain NENxxxx standards in which this specific standard is obliged to use when constructing a building.

In some other cases, there is no specific need for a national standards on a subjects. If NEN judges this to be true they then follow the available CEN/ISO norms for the specific subject. In this case the make these standards available on their website.

In relation to BIM there are not a lot of NEN standards yet. However, they have announced to start with national standards for BIM, based on the plans of CEN to start with EU-standards in relation to BIM. The Dutch commission of 'Automation systems and integration' already participates in international standard bodies for BIM-related standards and will advocate the Dutch input in these conversations.

NEN is currently a member of:

- International Organisation for Standardization (ISO);
- International Electrotechnical Commission (IEC);
- European Committee for Standardization (CEN);
- European Committee for Electrotechnical Standardization (CENELEC);
- European Telecommunications Standards Institute (ETSI).

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g. Lithuania

The digitization processes of construction in Lithuania are coordinated by one institution (Public Institution "Digital Construction"). This ensures the creation of a unified BIM methodology and the balanced management of BIM development processes. Public institution "Digital construction" (established by 13 construction sector associations) mainly developing and promoting BIM methodology in Lithuania, official established at 2014 (www.digitalconstruction.lt; www.skaitmeninestatyba.lt).

Main activities:

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- From 2012 organizing annual international conferences.
- From 2016 – organizing best Lithuanian BIM project contest.
- BIM methodology guides and templates are under development.
- From 2017, together with Lithuanian Builders association started BIM competences development model and started BIM trainings for construction and design companies.
- Digital Construction is preparing to carry out the assessment of BIM specialists' competences in Lithuania. The aim is to ensure that the certificates of competences issued by Digital Construction are recognized in other countries as well.
- At the end of 2017, 3 BIM related competences profiles were developed and presented.

Participants in the construction sector (companies, associations) are benevolent and active in the implementation of Digital Construction in Lithuania.

Lithuania represented by public organization “Digital construction” from 2015 is an associated member of BuildingSmart Nordic (together with Denmark, Sweden, Finland). Lithuania and Estonia are associate members. 2017.12 Lithuania presented request to become official chapter member of BuildingSmart Nordic chapter.

Lithuanian Builders Association implements the project (STATREG) to launch national Construction Workers Competencies Digital Register aimed to collect and provide information regarding the qualifications and skills, trainings, qualifications development opportunities, and the certification process for workers. Register will include employee's Digital CV's.

On September 28, 2015 The Government of the Republic of Lithuania officially recognized the initiative for the digitization of the Lithuanian construction sector.

On November 3, 2015 Lithuanian Ministry of Environment approved a working group for the implementation of the Lithuanian construction sector digitization initiative. The main result of the activities of working group “Feasibility study of Lithuanian construction sector digitalization possibilities” were developed by Public Institution “Digital construction” during 2016-2017. Based on study results, government working group prepared plan for Lithuanian construction sector digitalization for 2017-2021.

In Lithuania, there are still no legal requirements for BIM processes and BIM competencies. No law for mandatory BIM use in Lithuania. However, some public organizations starting use BIM requirements in their projects. As example, Lithuanian Real state bank started use BIM requirements in their modernization projects; Universities and hospitals also started use BIM requirements within some their construction related projects;

So far, only two ISO standards have been adapted in Lithuania: LST ISO 29481-2:2017 "Building information models – Information delivery manual – Part 2: Interaction framework" and LST ISO/TS 12911:2015 "Framework for building information modelling (BIM) guidance".

EU public procurement directive is implemented, but article related with BIM is implemented just as recommendation.

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In Lithuania construction digitization takes place mainly at the expense of private initiatives. Although, even as "digital construction" is included in the list of priority research and innovation areas called "Smart Specialization" as a strategy for state support to research and innovation, there is no significant support from the state. Since the preparation of the strategy in 2012 the institution coordinating the digitization of construction in Lithuania did not receive support to BIM related research from the national funds.

First formal Education (Master's Degree) study program “Building Information Modelling” developed and implemented in Vilnius Gediminas Technical University in 2015.

www.lsd.lt

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6. Standardization in Europe

The European Committee for Standardization (CEN) is a public standards organization founded in 1961. It aims at fostering the EU economy in global trading, the European citizens' welfare and the environment by providing an efficient infrastructure to interested parties for the development, maintenance and distribution of coherent sets of standards and specifications.

It is composed of 34 members:

- National Standardization Bodies of the 28 EU countries,
- the Former Yugoslav Republic of Macedonia, Serbia and Turkey,
- 3 countries of the European Free Trade Association: Iceland, Norway and Switzerland.

These members work together to develop European Standards in several sectors to build a European internal market for goods and services and to position Europe in the global economy.

CEN is officially recognized as a European standards body by the EU and by the European Free Trade Association (EFTA) as being responsible for developing and defining voluntary standards at European level; the other official European standards bodies are the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI). CEN is the officially recognized standardization representative for sectors different than electrotechnical (CENELEC) and telecommunications (ETSI).

More than 60,000 technical experts as well as business federations, consumer and other societal interest organizations are involved in the CEN network that reaches over 460 million people. CEN is contributing to the objectives of the EU and European Economic Area with technical standards (EN standards) which promote free trade, workers' and consumers' safety, interoperability of networks, environmental protection, exploitation of research and development programs, and public procurement.

An example of mandatory standards are those for materials and products used in construction and listed under the Construction Products Directive. The CE mark is a declaration by the manufacturer that a product complies with the respective EU directive and hence the harmonized standard(s) referenced by the directive(s).

CEN (together with CENELEC) owns the Keymark, a voluntary quality mark for products and services. A product bearing the Keymark demonstrates conformity to European Standards.

A high number of sectors are being addressed by both CEN and the CENELEC in the framework of their joint activities. The construction sector is one of Europe's biggest industries, representing around 10% of GDP and 50,5% of Gross fixed Capital formation. It employs more than 12 million EU citizens and it is estimated that 26 million workers in the European Union depend, on the construction sector, in one way or another.

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The construction sector in CEN covers more than 3000 work items on product standards and test methods (for use in building and civil engineering). Of these, about 600 standards started to be prepared under the Construction Products Directive (CPD) and are or will be harmonized under the Construction Products Regulation (CPR), along with about 1500 supporting standards (test methods).

By using harmonized standards, the manufacturer will be in position to make the declaration of performance (DoP) of his product as defined in the Construction Products Regulation (CPR) and to affix the CE marking.

Regarding Energy Performance of Buildings, the basis for the standardization work to be carried out by CEN, CENELEC and ETSI is found in the current set of Energy Performance of Buildings Directive (EPBD) related CEN standards, as well as other existing national, CEN/CENELEC and ISO standards. The improved set of EPBD standards shall become a systematic, clear and comprehensive package for the benefit of professionals, Member States and relations with third countries. In order to ensure user-friendliness, a continuous modular overall structure is needed, covering all standards related to the energy performance of buildings, providing the overall framework which will enable a step-by-step implementation by the EU Member States.

The mandated works include guidance on the rationalization of different options given in the standards, providing a balance between the accuracy and level of detail, on one hand, and the simplicity and availability of input data, on the other. Hidden complexities will also be taken into account, such as the impact of differences in the overall legal frameworks on the national choices and national input data.

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7. CEN existing standards on BIM: state-of-the- art

The European Committee for Standardization (CEN) created a Working Group, CEN/BT WG215 (BIM), aimed at studying the relevance and convenience of creating a specific Technical Committee of Standardization about BIM, as well as to define its scope, structured according to a roadmap.

This working group carried out its activity during 2014, and in 2015 the Technical Committee CEN/TC 442 *Building Information Modelling* was created. This Committee is in charge of harmonizing BIM at the European level. Also, it intends all the new documents to be done in coordination with the international organization, ISO/TC 59/SC 13, thus allowing the new standards to contribute to the worldwide BIM harmonization.

Finally, different alliances with BuildingSmart have been created.

The committee is developing a structured set of standards, specifications and reports which specify methodologies to define, describe, exchange, monitor, record and securely handle asset data, semantics and processes with links to geospatial and other external data.

The TC decided to start the approval process on the adoption of:

- ISO 16739:2013 - Industry Foundation Classes;
- ISO 29481-2 Building Information Modelling - Information Delivery Manual - Part 2 Interaction Framework;
- ISO 12006 Building Construction - Organization of Information about Construction Works - Part 3: Framework for object oriented information.

Regarding structure, it is composed of 5 working groups:

- Working Group 1 - Terminology
- Working Group 2 - Exchange information
- Working Group 3 - Information Delivery Specification
- Working Group 4 - Support Data Dictionaries
- Working Group 5 – Chairperson's Advisory Group

The CEN/TC 442 Working Plan has the following aims:

- Adoption of the main BIM international standards (ISO) as European standards (EN). The procedures for the adoption of ISO Standards 12006-3: 2007 (IFD), ISO 16739: 2013 (IFC), ISO 29481-1: 2016 (IDM) and ISO 29481-2: 2012 (IDM) have been started.

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- Cooperation with ISO in the development of new standards, such as the projects prEN ISO 19650-1 and prEN ISO 19650-2.

- Consideration of related European standards, with special emphasis on sustainability and environmental aspects. The work of the Technical Committee CEN/TC 350, Sustainability in construction, will be taken into account, mainly in relation to the estimation and evaluation of the life cycle.

- Development of European technical reports defining the current scenario, focusing on terminology, roles, stages, European purchasing methodology and definition of the processes for exchanging information in construction.

- Exchange of information and IFC standards, expanding and developing new standards for industrial facilities and infrastructures.

- Development of new European specifications about the exchange of information, in order to harmonize the request for building licenses or property management, as an example.

- Development of new documents related to data dictionaries and their definition methods. Harmonization of the definition of the properties of construction products.

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8. EU BIM Task Group

With the aim of bringing together and aligning the development of BIM strategies from different European countries, representatives of Public Administrations of 14 Member States have joined efforts setting up the EU BIM Task Group, which is being funded by the European Commission.

Europe is the territory with the world's largest concentration of BIM Implementation Programs led by Public Administrations. The Nordic countries have been pioneers in the development of BIM processes, being Finland and Norway the first to establish a regulation in this respect. Later, the European Commission defined public procurement policies and shortly thereafter, the UK and the Netherlands also saw the opportunity to join BIM. Later, joint initiatives were organized between the Government and industry in Spain, Germany and France.

The BIM Task Group, whose mission is to develop a world-class digital construction sector, held the first official meeting of its Steering Committee in Brussels on 19 January 2016. The Group is represented by Administrations (Public tenderers, infrastructure managers and real estate asset managers) in the following countries: Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Italy, Spain, Sweden, Netherlands, Norway, Portugal and the UK.

The European Commission has financed the EU BIM Task Group during 2016 and 2017 in order to develop "a common European concept and guideline for aligning the use of BIM in public works". The Group has present its objectives and activities through a series of conferences throughout Europe, in order to increase the number of public administrations and promote collaboration with industry.

The focus of the group has been to develop a handbook (launched in July 2017, English version) containing the common principles for public procurers and policy makers to consider when introducing BIM to their public works or strategies. The handbook includes procurement measures, technical considerations, cultural and skills development; and the benefits case for BIM and 'going digital' for policy makers and public clients. Currently, the handbook is being translated into the national languages of the participating countries.

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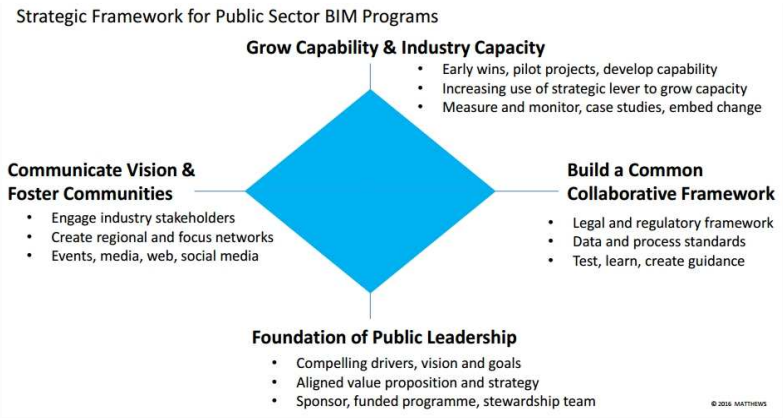

9. Building SMART

BuildingSMART is an international organisation which aims at improving the exchange of information between the different software applications used in the construction industry. It has developed Industry Foundation Classes (IFCs) as a neutral and open specification for BIM.

BuildingSMART develops and maintains international standards for openBIM, combining:

- buildingSMART Processes - information delivery manuals.
- buildingSMART Data Dictionary - it maintains the International Framework for Dictionaries (IFD) Library.
- buildingSMART Data model - the organisation manages the software-neutral Industry Foundation Classes (IFC) data model

Industry Foundation Class (IFC) standards were the first developed by buildingSMART for sharing and exchanging BIM data across different softwares. buildingSMART continues to update the IFC standard and is developing a range of other standards to serve the building and infrastructure industries.

buildingSMART has developed partnerships with two global standards organizations to support its objectives: International Organization for Standardization (ISO) and Open Geospatial Consortium (OGC)[4].

[4] The OGC (Open Geospatial Consortium) is an international not for profit organization committed to making quality open standards for the global geospatial community.

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Besides, it has elaborated different 'chapters', which are national membership organizations sharing the vision and goals of buildingSMART International, and also develop and promote the use of openBIM in their countries.

10. CEN standardization and certification processes and procedures

The activities related to standardization of CEN are responsibility of the CEN Technical Board, who are in charge of the execution of CEN's work program. Standards are prepared by Technical Committees (TCs), each of them having its own field of operation within which a work program of identified standards is developed and executed. TCs work on the basis of national participation by the CEN Members, where delegates represent their respective national perspective. This principle allows the TCs to take balanced decisions that reflect a wide consensus. Also, a Subcommittee may be established within a TC, in the case of large programs of work.

The real standards development is undertaken by Working Groups (WGs) where experts, appointed by the CEN Members but speaking in a personal capacity, come together and develop a draft that will become the future standard. This reflects an embedded principle of direct participation in the standardization activities.

Workshops are particularly relevant in emerging or rapidly-changing technologies that require quickly-developed specifications or results of research projects. They produce CEN and/or CENELEC Workshop Agreements (CWAs).

In order to prepare and produce state-of-the-art standards, CEN relies on the knowledge of nearly 50.000 experts, who participate in various technical activities through a network of 50 National Standards Bodies (34 Members plus 16 Affiliates) and continuous cooperation with organizations representing different stakeholders (including consumers, workers, environmental interests and SMEs).

The CEN Technical Board (CEN/BT) is responsible for the coordination and management of the standards development work that is being carried out in more than 320 TCs. In addition to overseeing these activities, as well as their related processes, the CEN Technical Board is also responsible for evaluating and addressing requests for standardization on new subjects.

The development of a European Standard (EN) is governed by the principles of consensus, openness, transparency, national commitment and technical coherence and follows several steps:

1. **Proposal to develop an EN.** Any interested party can introduce a proposal for new work. Most standardization work is proposed through the CEN Members.

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2. **Acceptance of the proposal.** Once a project to develop an EN is accepted by the relevant Technical Body, or by the Technical Board, the member countries shall put all national activity within the scope of the project on hold. This means that they do not initiate new projects, nor revise existing standards at national level. This obligation is called 'standstill' and allows efforts to be focused on the development of the EN.

3. **Drafting.** The EN is developed by experts within a Technical Body.

4. **Enquiry – Public comment at national level & weighted vote.** Once the draft of an EN is prepared, it is released for public comment and vote, a process known as the 'Enquiry'. During this stage, everyone who has an interest (e.g. manufacturers, public authorities, consumers, etc.) may comment on the draft. These views are gathered by the members who then submit a national position by means of a weighted vote and which is subsequently analyzed by the CEN Technical Body. If the results of the Enquiry show approval for the EN then the Technical Body can decide to publish the Standard.

5. **Adoption by weighted Formal Vote.** If the results of the Enquiry show that the draft EN requires technical reworking the Technical Body can decide to update the draft and resubmit it for another weighted vote, called the Formal Vote.

6. **Publication of the EN.** Following the approval of the EN, either from the Enquiry or the Formal Vote, the EN then is published. A published European Standard must be given the status of national standard in all member countries, who also have the obligation to withdraw any national standards that conflict with it. This guarantees that a manufacturer has easier access to the market of all the member countries when applying European Standards and this also applies whether the manufacturer is based in a member's territory or not.

7. **Review of the EN.** To ensure that a European Standard is still current, it is reviewed within five years of its publication. This review results in the confirmation, modification, revision or withdrawal of the EN.

On the other hand, the Vienna Agreement provides a framework for technical cooperation between CEN and the ISO. It provides provisions relating to the exchange of information between ISO and CEN, mutual representation at meetings, and parallel approval of standards.

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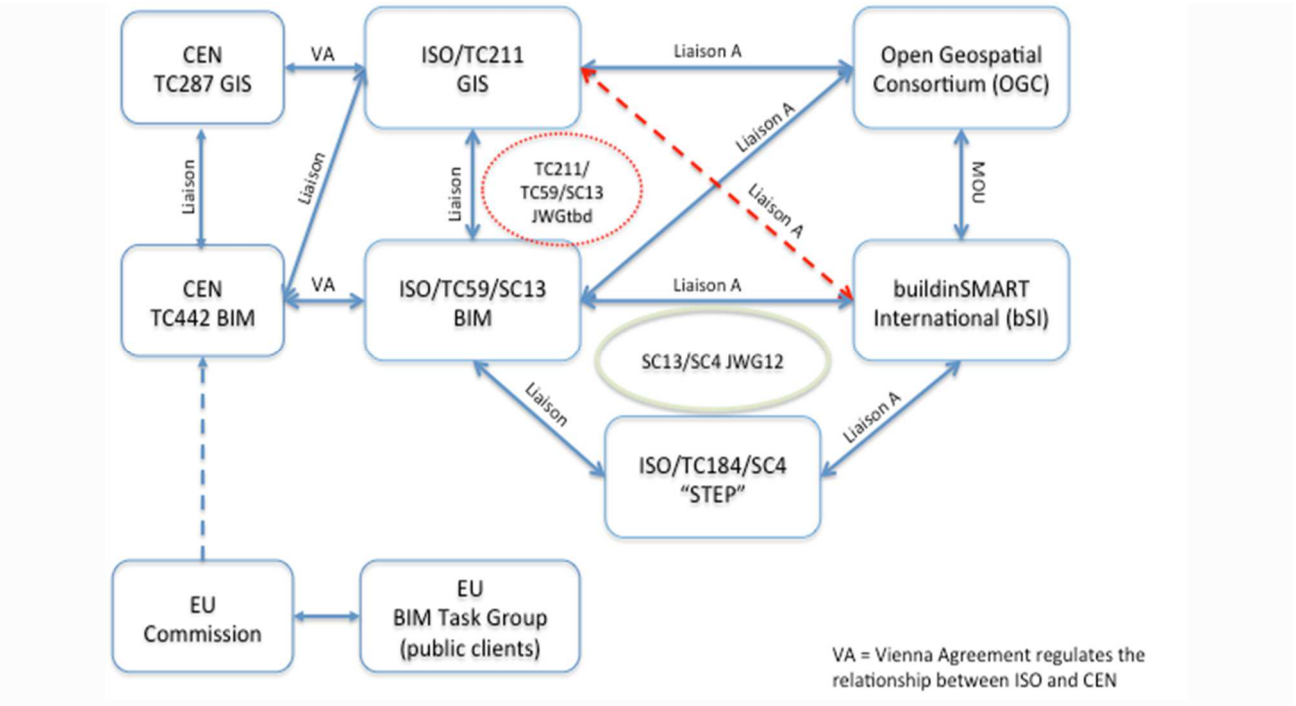

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11. Bridges between CEN methodology and NetUBIEP project

As one of the main aims of Net-UBIEP project is the standardization at European level of the schemes for BIM Qualification Model, the consortium will design the tools required to be presented to the regulatory body (CEN) for the recognition of the BIM professional profiles. This work will be proposed at CEN TC/442, in order to define competences of professionals and workers in the building sector on BIM, in agreement with energy performance requirements.

The purpose is to capitalize the work done in Net-UBIEP project at a European level and to propose an EN standard for the qualification of BIM professional experts in energy performance of buildings. The standardization will be entailed through the presentation of a technical document to the CEN, in particular to CEN/BT/WG 215 which works in close relationship with ISO/TC 59/SC 13 – Organization of information about construction works. At this purpose five partners, ENEA and CSA (IT), FLC (ES), VGTU (LT) and ISSO (NL) will travel to Brussels to present Net-UBIEP outputs.

The qualification training schemes we intend to develop for the energy BIM experts will be developed within BUS and BIM communities and the intent is to purpose them within CEN and ISO standardization work.

The results of WP4 (Validation of BIM qualification models) will be the basis for the development of standardization schemas for BIM energy performance competences as well as for the definition of recommended practices for Public Administrations, Owners and Facility Managers of buildings.

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ANNEX I

ISO-CEN STANDARDS

ISO/CD 6707-1 Buildings and civil engineering works — Vocabulary — Part 1: General terms

ISO 12006-2:2015 Building construction -- Organization of information about construction works -- Part 2: Framework for classification

ISO 12006-3:2007 Building construction -- Organization of information about construction works -- Part 3: Framework for object-oriented information

ISO/TS 12911:2012 Framework for building information modelling (BIM) guidance

ISO 16354:2013 Guidelines for knowledge libraries and object libraries

ISO 16757-1:2015 Data structures for electronic product catalogues for building services -- Part 1: Concepts, architecture and model

ISO 22263:2008 Organization of information about construction works -- Framework for management of project information

ISO 29481-1:2016 Building information models -- Information delivery manual -- Part 1: Methodology and format

ISO 29481-2:2012 Building information models -- Information delivery manual -- Part 2: Interaction framework

ISO/NP 16739-1 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries -- Part 1: Data schema using EXPRESS schema definitions

ISO 16757-2 Data structures for electronic product catalogues for building services -- Part 2: Geometry

ISO/CD 19650-1 Organization of information about construction works -- Information management using building information modelling -- Part 1: Concepts and principles

ISO/CD 19650-2 Organization of information about construction works -- Information management using building information modelling -- Part 2: Delivery phase of assets

ISO/NP 21597 Information container for data drop (ICDD)

ISO 15686

ISO 15686-4:2014 Preview Building Construction -- Service Life Planning -- Part 4: Service Life Planning using Building Information Modelling

ISO 15686-2:2012 Preview Buildings and constructed assets -- Service life planning -- Part 2: Service life prediction procedures

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ISO 15686-7 Buildings and constructed assets -- Service life planning -- Part 7: Performance evaluation for feedback of service life data from practice

PAS 1192 PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modelling parti

PAS1192:3 Specification for information management for the operational phase of assets using building information modelling

EN ISO 12006-3:2016 Building construction - Organization of information about construction works - Part 3: Framework for object-oriented information (ISO 12006-3:2007)2016-10-19

EN ISO 16739:2016 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries (ISO 16739:2013)

ISO 37120:2014 Sustainable development and resilience of communities - Indicators for city services and quality of life

ISO/TR 37150 Smart community infrastructures - Review of existing activities relevant to metrics

ISO 37101 Sustainable development and resilience of communities - Management systems - General principles and requirements

ISO 37102 Sustainable development and resilience of communities – Vocabulary

ISO/TR 37121 Inventory and review of existing indicators on sustainable development and resilience in cities

ISO/TS 37151 Smart community infrastructure metrics - General principles and requirements

ISO/TR 37152 Smart community infrastructures -- Common framework for development and operation

Standard and/or project under the direct responsibility of ISO/TC 59/SC 13 Secretariat

ISO 12006-2:2015 Building construction -- Organization of information about construction works -- Part 2: Framework for classification

ISO 12006-3:2007 Building construction -- Organization of information about construction works -- Part 3: Framework for object-oriented information

ISO 16354:2013 Guidelines for knowledge libraries and object libraries

ISO 16757-1:2015 Data structures for electronic product catalogues for building services -- Part 1: Concepts, architecture and model

ISO 16757-2:2016 Data structures for electronic product catalogues for building services -- Part 2: Geometry

ISO 22263:2008 Organization of information about construction works -- Framework for management of project information

ISO 29481-1:2016 Building information models -- Information delivery manual -- Part 1: Methodology and format

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ISO 29481-2:2012 Building information models -- Information delivery manual -- Part 2: Interaction framework

ISO/TS 12911:2012 Framework for building information modelling (BIM) guidance.

ISO/TS 12911:2012 establishes a framework for providing specifications for the commissioning of building information modelling (BIM). It is applicable to any range of modelling of buildings and building-related facilities, from a portfolio of assets at a single site or multiple sites, to assets at a single small building and at any constituent system, subsystem, component or element. It is applicable to any asset type, including most infrastructure and public works, equipment and material. BIM processes are applicable across the entire life cycle of a portfolio, facility or component, which can span inception to end-of-use. The main user of the framework is the information manager, who utilizes the framework to assist in structuring an international-, national-project- or facility-level BIM guidance document. The framework can also be used for BIM guidance provided by application providers.

ISO 12006-2: 2015 Building construction - Organization of information about construction works -- Part 2: Framework for classification.

ISO 12006-2:2015 defines a framework for the development of built environment classification systems. It identifies a set of recommended classification table titles for a range of information object classes according to particular views, e.g. by form or function, supported by definitions. It shows how the object classes classified in each table are related, as a series of systems and sub-systems, e.g. in a building information model. ISO 12006-2:2015 does not provide a complete operational classification system, nor does it provide the content of the tables, though it does give examples. It is intended for use by organizations which develop and publish such classification systems and tables, which may vary in detail to suit local needs. However, if this part of ISO 12006 is applied in the development of local classification systems and tables, then harmonization between them will be facilitated. ISO 12006-2:2015 applies to the complete life cycle of construction works, including briefing, design, documentation, construction, operation and maintenance, and demolition. It applies to both building and civil engineering works, including associated engineering services and landscaping.

ISO 12006-3:2007 specifies a language-independent information model which can be used for the development of dictionaries used to store or provide information about construction works. It enables classification systems, information models, object models and process models to be referenced from within a common framework.

The aim of ISO 16354:2013 is to distinguish categories of knowledge libraries and to lay the foundation for uniform structures and content of such knowledge libraries and for commonality in their usage. By drawing up a number of guidelines, a guiding principle is provided for new libraries as well as for upgrading existing libraries. Without these guidelines there is an undesirable amount of freedom, so that the various libraries may become too heterogeneous. This would render the comparison, linking and integrated usage of these libraries very complex, if not impossible.

The objective of ISO 16354:2013 is to categorize knowledge libraries and object libraries and to provide recommendations for the creation of such libraries. Libraries that are compliant with the guidelines of ISO 16354:2013 may be more easily linked to, or integrated with other libraries.

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The target audience of ISO 16354:2013 consists of developers of knowledge libraries, builders of translation software or interfaces between knowledge libraries, certifying bodies and builders of applications who must base their work on the knowledge libraries laid down.

ISO 16757-1:2015 Data structures for electronic product catalogues for building services -- Part 1: Concepts, architecture and model

The primary purpose of ISO 16757 is the provision of data structures for electronic product catalogues to transmit building services product data automatically into models of building services software applications. This includes a meta model for the specification of product classes and their properties and a meta model for the product data which is exchanged in product catalogues. Product data has to follow the specifications for their product groups.

ISO 16757-1:2015 specifies the underlying concepts, a generic model specifying the available modelling elements and their relationships, and a framework for the specification of the Content Parts by describing the elements which are to be provided by these Parts.

ISO 16757-2:2016 describes the modelling of building services product geometry. The description is optimized for the interchange of product catalogue data and includes

- shapes for representing the product itself,
- symbolic shapes for the visualization of the product's function in schematic diagrams,
- spaces for functional requirements,
- surfaces for visualization, and
- ports to represent connectivity between different objects.

The shape and space geometry is expressed as Constructive Solid Geometry (CSG) based on geometric primitives concatenated to boundary representations by Boolean operations.

ISO 16757-2:2016 uses the applicable primitives from ISO 10303-42 and from ISO 16739 and adds primitives which are required for the special geometry of building services products. For symbolic shapes, line elements are also used.

ISO 16757-2:2016 neither describes the inner structure and internal functionality of the product nor the manufacturing information because this is typically not published within a product catalogue.

Building services products can have millions of variant dimensions. To avoid the exchange of millions of geometries, a parametric model is introduced which allows the derivation of variant-specific geometries from the generic model. This is necessary to reduce the data to be exchanged in a catalogue to a manageable size. The parametric model will result in smaller data files, which can be easier transmitted during data exchanges.

The geometry model used does not contain any drawing information such as views, line styles or hatching.

ISO 22263:2008 specifies a framework for the organization of project information (process-related as well as product-related) in construction projects. Its purpose is to facilitate control, exchange, retrieval and use of relevant information about the project and the construction entity. It is intended for all agents in the project organization in management of the construction process as a whole and in coordination of its sub-processes and activities.

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This framework consists of a number of generic parameters that are applicable to projects of varying complexity, size and duration and is adaptable to national, local and project-specific variations of the construction process.

ISO 29481-1:2016 specifies:

- a methodology that links the business processes undertaken during the construction of built facilities with the specification of information that is required by these processes, and
- a way to map and describe the information processes across the life cycle of construction works.

ISO 29481-1:2016 is intended to facilitate interoperability between software applications used during all stages of the life cycle of construction works, including briefing, design, documentation, construction, operation and maintenance, and demolition. It promotes digital collaboration between actors in the construction process and provides a basis for accurate, reliable, repeatable and high-quality information exchange.

ISO 29481-2:2012 specifies a methodology and format for describing 'coordination acts' between actors in a building construction project during all life cycle stages. It therefore specifies a methodology that describes an interaction framework, an appropriate way to map responsibilities and interactions that provides a process context for information flow, a format in which the interaction framework should be specified.

ISO 29481-2:2012 is intended to facilitate interoperability between software applications used in the construction process, to promote digital collaboration between actors in the building construction process, and to provide a basis for accurate, reliable, repeatable, and high-quality information exchange.

ISO/TS 12911:2012 establishes a framework for providing specifications for the commissioning of building information modelling (BIM). It is applicable to any range of modelling of buildings and building-related facilities, from a portfolio of assets at a single site or multiple sites, to assets at a single small building and at any constituent system, subsystem, component or element. It is applicable to any asset type, including most infrastructure and public works, equipment and material. BIM processes are applicable across the entire life cycle of a portfolio, facility or component, which can span inception to end-of-use. The main user of the framework is the information manager, who utilizes the framework to assist in structuring an international-, national-project- or facility-level BIM guidance document. The framework can also be used for BIM guidance provided by application providers.

ISO/TC 59/SC 13 Organization of information about construction works

ISO/DIS 19650-1 [Under development]

Organization of information about construction works -- Information management using building information modelling -- Part 1: Concepts and principles

ISO/DIS 19650-2 [Under development]

Organization of information about construction works -- Information management using building information modelling -- Part 2: Delivery phase of assets

ISO/NP 16739-1 [Under development]

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Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries -- Part 1: Data schema using EXPRESS schema definitions

ISO/NP 21597 [Under development]

Information container for data drop (ICDD)

ISO 16484-1:2010 Building automation and control systems (BACS) -- Part 1: Project specification and implementation

90.93 ISO/TC 205

ISO 16484-2:2004 Building automation and control systems (BACS) -- Part 2: Hardware

90.92 ISO/TC 205

ISO 16484-3:2005 Building automation and control systems (BACS) -- Part 3: Functions

90.60 ISO/TC 205

ISO 16484-5 [Under development]

Building automation and control systems (BACS) -- Part 5: Data communication protocol

60.00 ISO/TC 205

ISO 16484-5:2014 Building automation and control systems (BACS) -- Part 5: Data communication protocol

90.92 ISO/TC 205

ISO 16484-6:2014 Building automation and control systems (BACS) -- Part 6: Data communication conformance testing

60.60 ISO/TC 205

ISO/DIS 16484-2 [Under development]

Building automation and control systems (BACS) -- Part 2: Hardware

40.60 ISO/TC 205

ISO/DIS 19650-1 [Under development]

Organization of information about construction works -- Information management using building information modelling -- Part 1: Concepts and principles

40.20 ISO/TC 59/SC 13

ISO/DIS 19650-2 [Under development]

Organization of information about construction works -- Information management using building information modelling -- Part 2: Delivery phase of assets

40.20 ISO/TC 59/SC 13

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ISO/IEC 14543-2-1:2006 Information technology - Home electronic systems (HES) architecture -- Part 2-1: Introduction and device modularity

ISO/IEC JTC 1/SC 25 IT applications in building and construction industry

Construction industry in general

ISO/IEC 14543-3-10:2012 Information technology -- Home electronic systems (HES) architecture -- Part 3-10: Wireless short-packet (WSP) protocol optimized for energy harvesting -- Architecture and lower layer protocols

90.20 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-11:2016 Information technology -- Home electronic system (HES) architecture -- Part 3-11: Frequency modulated wireless short-packet (FMWSP) protocol optimised for energy harvesting -- Architecture and lower layer protocols

60.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-1:2006 Information technology -- Home electronic systems (HES) architecture -- Part 3-1: Communication layers -- Application layer for network based control of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-2:2006 Information technology -- Home Electronic Systems (HES) Architecture -- Part 3-2: Communication layers -- Transport, network and general parts of data link layer for network based control of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-3:2007 Information technology -- Home electronic system (HES) architecture -- Part 3-3: User process for network based control of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-4:2007 Information technology -- Home electronic system (HES) architecture -- Part 3-4: System management -- Management procedures for network based control of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-5:2007 Information technology -- Home electronic system (HES) architecture -- Part 3-5: Media and media dependent layers -- Power line for network based control of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-6:2007 Information technology -- Home electronic system (HES) architecture -- Part 3-6: Media and media dependent layers -- Network based on HES Class 1, twisted pair

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-3-7:2007 Information technology -- Home electronic system (HES) architecture -- Part 3-7: Media and media dependent layers -- Radio frequency for network based control of HES Class 1

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90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-4-1:2008 Information technology -- Home electronic system (HES) architecture -- Part 4-1: Communication layers -- Application layer for network enhanced control devices of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-4-2:2008 Information technology -- Home electronic system (HES) architecture -- Part 4-2: Communication layers -- Transport, network and general parts of data link layer for network enhanced control devices of HES Class 1

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-4-3:2015 Information technology -- Home Electronic Systems (HES) architecture -- Part 4-3: Application layer interface to lower communications layers for network enhanced control devices of HES Class 1

60.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-1:2010 Information technology -- Home electronic system (HES) architecture -- Part 5-1: Intelligent grouping and resource sharing for Class 2 and Class 3 -- Core protocol

90.93 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-21:2012 Information technology -- Home electronic system (HES) architecture -- Part 5-21: Intelligent grouping and resource sharing for HES Class 2 and Class 3 -- Application profile -- AV profile

90.20 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-22:2010 Information technology -- Home electronic system (HES) architecture -- Part 5-22: Intelligent grouping and resource sharing for HES Class 2 and Class 3 -- Application profile -- File profile

90.93 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-3:2012 Information technology -- Home electronic system (HES) architecture -- Part 5-3: Intelligent grouping and resource sharing for HES Class 2 and Class 3 -- Basic application

90.20 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-4:2010 Information technology -- Home electronic system (HES) architecture -- Part 5-4: Intelligent grouping and resource sharing for HES Class 2 and Class 3 -- Device validation

90.60 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-5:2012 Information technology -- Home electronic system (HES) architecture -- Part 5-5: Intelligent grouping and resource sharing for HES Class 2 and Class 3 -- Device type

90.20 ISO/IEC JTC 1/SC 25

ISO/IEC 14543-5-6:2012 Information technology -- Home electronic system (HES) architecture -- Intelligent grouping and resource sharing for HES Class 2 and Class 3 -- Part 5-6: Service type

90.20 ISO/IEC JTC 1/SC 25

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ISO/IEC 14543-5-7:2015 Information technology -- Home electronic system (HES) architecture -- Part 5-7: Intelligent grouping and 3 resource sharing -- Remote access system architecture

60.60 ISO/IEC JTC 1/SC 25

ISO/IEC CD 14543-5-101 [Under development]

Information technology -- Home electronic systems (HES) architecture -- Part 5-101: Intelligent grouping and resource sharing remote AV access profile

30.99 ISO/IEC JTC 1/SC 25

ISO/IEC CD 14543-5-102 [Under development]

Information technology -- Home electronic system (HES) architecture -- Part 5-102: Intelligent grouping and resource sharing -- Remote universal management profile

30.99 ISO/IEC JTC 1/SC 25

ISO/IEC CD 14543-5-11 [Under development]

Information technology -- Home electronic systems (HES) architecture -- Part 5-11: Intelligent grouping and resource sharing -- Remote user interface

30.99 ISO/IEC JTC 1/SC 25

ISO/IEC CD 14543-5-12 [Under development]

Information technology -- Home electronic systems (HES) architecture -- Part 5-12: Intelligent grouping and resource sharing -- Remote access test and verification

30.99 ISO/IEC JTC 1/SC 25

ISO/IEC DIS 14543-5-8 [Under development]

Information technology -- Home electronic systems (HES) architecture -- Part 5-8: Intelligent grouping and resource sharing for Class 2 and Class 3 -- Remote access core protocol

40.60 ISO/IEC JTC 1/SC 25

ISO/IEC DIS 14543-5-9 [Under development]

Information technology -- Home electronic systems (HES) architecture -- Part 5-9: Intelligent grouping and resource sharing for class 2 and class 3 -- Remote access service platform

40.60 ISO/IEC JTC 1/SC 25

ISO/IEC TR 14543-4:2002 Information technology -- Home Electronic System (HES) architecture -- Part 4: Home and building automation in a mixed-use building

90.60 ISO/IEC JTC 1/SC 25

ISO/WD 16484-7 [Under development]

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Building automation and control systems (BACS) -- Part 7: Contribution of BACS to energy performance of buildings

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ANNEX II:

ISO. GLOSSARY OF TERMS AND ABBREVIATIONS

http://www.iso.org/sites/ConsumersStandards/5_glossary.html

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