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1 Executive Summary

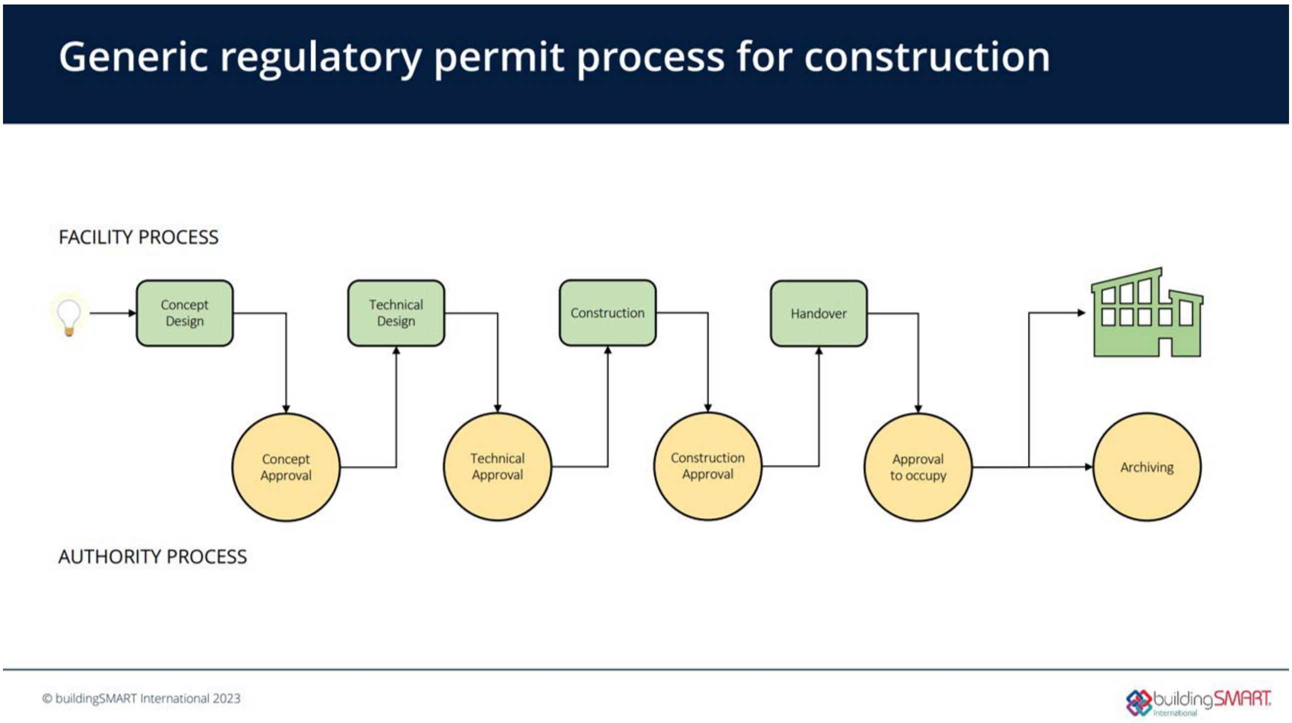
2 Introduction

The use of Building Information Modelling (BIM) in digital building permitting has been growing in recent years and is becoming increasingly important for the construction industry.

This report aims to explore the use of BIM in digital building permitting and its optimizations on the regulatory bodies and their needs to project to adopt it.

2.1 Regulatory bodies

A buildingSMART research monitored globally a generic permit process for construction as reported in the following figure.



During years through countries the structures of the industry responsible for the facility processes look to converge globally to a standardized model.

Actually, we could say that worldwide the construction industry consist in a wide number of firms with specific roles (the so called Architecture Engineering Construction [AEC] ecosystem) with some more structured firms collecting many of these competences and running usually as main contractors in projects.

From the same global point of view, the structure of the regulatory bodies running the authority process reported in the permit process for construction looks a less standardized ecosystem even though the activities they perform in checking are globally similar.

This manly depends on differences in local and/or national jurisdictions.

In some countries the process is fully run in a dedicated public service, but in a majority of them there is a complex structure of bodies sometimes belonging both from public and private entities that run the project.

By the way even in countries with a full public service the regulatory process goes through different offices; so when we talk about an innovative regulatory process for construction from a regulatory point of view, we have to consider there is an external (industry – regulatory) and internal communication project to put in place.

SINGAPORE CS

https://www1.bca.gov.sg/regulatory-info/building-control/corenet-x/corenet-x-faqs/general-information

Singapore is one of the countries that first experimented a digital process for approval in construction.

Launched in November 2001, the Construction & Real Estate Network (or CORENET) is a Government to Business system that enables built environment professionals to make project-related electronic submissions to regulatory agencies for approval within a secured environment, from anywhere at any time.

At the moment Singapore is launching a new system to support the process, CORENET-X, let's see why

When CORENET was introduced in 2001, the system allows separate submissions to the various agencies for regulatory approval based on project progress. This supports expedience and is pro-business for the industry. Nonetheless, this is not without trade-offs. The practice of separate submissions based on project progress also meant that the plans are prepared and submitted at different stages of a project. Consequentially, the regulatory agencies would review the plans at different stages and convey their respective comments. Industry practitioners would have to address these comments and incorporate them into their design and re-submissions while ensuring that the changes will not affect what had been previously approved by the other agencies.

The advent of BIM and emerging technologies presents the opportunity for the current modus operandi of the regulatory approval process to transform, becoming more integrated and smarter.

CORENET X will change the current practice of requiring each consultant to deal separately with multiple agencies to one where the project team comes together to produce and submit a coordinated BIM model for respective agencies to extract information for compliance review. Agencies will review the submission collectively and provide a consolidated response to the project team. The integrated submission process will improve regulatory governance and synergy among agencies, providing a One-Stop Integrated Digital Shopfront experience

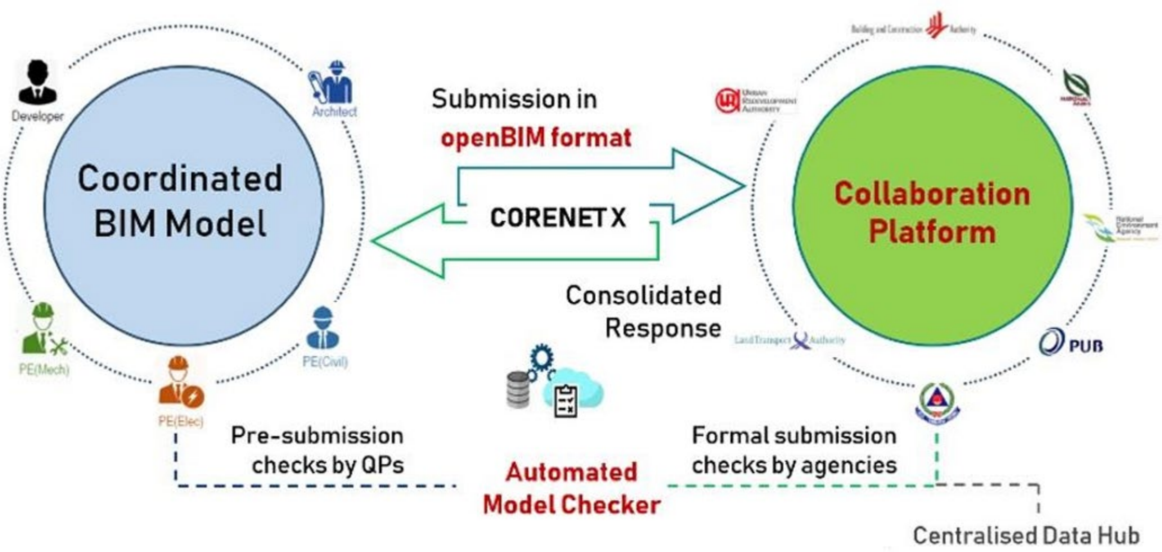


Figure 0-3 - Coordinated process in CORENET X

2.2 BIM and OpenBIM

Building Information Modelling (BIM) is a collaborative approach/methodology for the construction industry that is leveraged by the digital representation of the physical and functional characteristics of a building. It integrates all aspects of building design, construction, and operations into a single digital model.

It is important to understand that BIM is different from CAD (Computer Aided Design). CAD is a 2D or 3D digitalized drawing that consists of lines, curves, shapes and symbols that represent the design of the building while BIM is a methodology for collaboration and communication between all stakeholder of AEC industry at any stage of the construction process and all this ….. that contains not only the geometry of the building, but also the technical components and information related to each element, such as materials, properties, functions, costs, etc. so BIM can support the entire lifecycle of the building, from design to construction to operation and maintenance, as it can store and manage all the relevant information in one place.

The concept of BIM appeared in the 1970s, and time after time the meaning of “building” in this acronym extended, and now also designates all types of infrastructure (e.g., bridges, railways) as well as the act of construction.

OpenBIM is the collaborative approach to Building Information Modelling (BIM) that focuses on interoperability and open standards. It is an initiative that seeks to promote open collaboration and data exchange among different software applications used in the architecture, engineering, and construction (AEC) industry.

The term "**open**" in OpenBIM refers to the use of *non-proprietary* standards, such as the Industry Foundation Classes (IFC) data format, which enables different software applications to share information in a common and standardized way. This helps to ensure that project data can be shared and used by all stakeholders, regardless of the software they use.

OpenBIM also emphasizes collaboration among project team members, including architects, engineers, contractors, and owners. By using open standards and interoperable software, project teams can work together more efficiently and effectively, reducing errors and rework, and improving project outcomes.

2.3 BIM, GIS and CIM

The Geospatial Information System (GIS) is designed to save, store, manipulate, manage, and present spatial or geographical data. It is the base technology for the well-known geographical services and tools we use in our mobile devices.

GIS has many other applications, for example decision-making, organizing a society's primary information systems, such as cadastral systems and national security, and automating technical workflows such as cartographic production and image analysis. In other words, the capacity of GIS can extend to carry out public policy decisions.

It stores, manages, and analyses the data in an urban environment while BIM does the same with data for buildings and urban infrastructure.

The integrated BIM-GIS approach is growing in popularity and beginning to serve an increasing number of applications in the different phases of a built asset's life cycle from planning and construction to demolition.

The BIM-GIS approach adopted on a city scale is also the groundwork for the so-called City Information Model (CIM).

CIM provides a series of models that form an integrated and rich semantic city containing structured, shared, and interconnected information, which offers a systemic view of a city. It allows the different stakeholders (e.g., managers, engineers, architects, and urbanists) to collaborate and work efficiently in real time on a single data source (model of the city), which in turn helps them make more informed decisions.

2.4 Digital Transformation in the building ecosystem

Compared to many other industries, the building industry has been somewhat slower to adopt digital transformation. One reason for the slower adoption of digital transformation in the building ecosystem is that it is a highly fragmented industry, with many small and medium-sized companies and municipalities that may lack the resources or expertise to implement digital technologies.

Additionally, construction projects are often highly customized, which can make it more challenging to develop standardized digital solutions. However, there has been significant progress in recent years, with many companies in the building industry investing in digital technologies and exploring new ways to improve efficiency, productivity, and sustainability.

A standardized and open tool as OpenBIM plays a crucial role in the digital transformation of the construction ecosystem and can be considered the central key factor to support the long-term transition that involves many other technologies as 3D printing, Internet of Things (IoT), augmented reality (AR) and Digital twins, that will interoperate and be integrated with OpenBIM.

2.5 OpenBIM in Building industry

OpenBIM has become increasingly important in the building industry as the construction process has become more complex and collaborative. It allows different stakeholders to work together more effectively, regardless of the software or tools they use.

The use of open standards and interoperable software in OpenBIM helps to promote collaboration among architects, engineers, contractors, and other stakeholders involved in the design and construction process. This collaboration leads to more efficient workflows and improved communication, reducing errors and rework.

OpenBIM also promotes the use of data management and analysis tools that allow stakeholders to better understand the impact of design decisions on the construction process and the building's performance. This includes tools for energy analysis, sustainability assessments, and lifecycle management.

In addition, OpenBIM facilitates the exchange of information across different stages of the building lifecycle, from design and construction to operation and maintenance. This helps to ensure that building information is accurate and up to date, which can improve the building's performance and reduce maintenance costs.

Least but not last, OpenBIM open standards prevent archived digital documents from digital data obsolescence, that refers to the process of data becoming outdated or inaccessible due to changes in technology or software over time.

Overall, OpenBIM is actually improving the efficiency, quality, resilience, and sustainability of building projects by promoting collaboration, openness, and interoperability among stakeholders in the building industry.

3 Why OpenBIM helps the regulatory process.

3.1.1 Open BIM advantages for regulators and the asset ecosystem

It's an established fact: The digitalization of the construction industry is far behind almost every other industry on a global scale. At the same time, the increase in productivity registered in most other industries is non-existent in construction, and it is generally accepted that these two facts are correlated.

The complexity of the construction industry also lies in the fact that there are heavy burdens of complex building regulations affecting all stakeholders but specially the regulatory bodies in different ways. When it comes to addressing the topics of sustainability or productivity there is a need to simplify the regulatory landscape. We need to build a framework for exchanging data in the market that supports initiatives, such as Digital Product Passport. We need regulatory will be based on to build standardized datasets or Data Templates to support a digital common language and increased interoperability and, as the framework is available, start to support a progressive and controlled automatic data checking.

BIM provides a source of federated and reusable information through 3D modelling. This can include geometry, spatial relations, geographical information, quantities and properties of construction elements, cost estimates, inventory material and project schedule. (Le & His ung,2014). The model can be used throughout the project life cycle (Bazjanac, 2006; Eastman et al.2011). BIM provides not only virtual 3D models, but also visualizations (Azhar, Nadeem, Mok,& Leung, 2008; Bentley, 2018; BIMhub, 2018) and a better understanding of a project. It also facilitates communication between stakeholders (Le & Hsiung, 2014). Therefore, the sharing and exchange of information is more efficient, and information circulates in real time throughout project development. BIM has a profound impact on construction project participants (Smith, 2014; Xiao& Noble, 2014) by reason of risk and knowledge sharing. It helps avoid serious financial losses and scheduling impacts.

Report here some numbers about the advantages of using BIM, reporting also the source of data.

Other examples of benefits come from the survey "Understanding the role of BIM and Common Data Environments ("CDE") today and expectations for the future", conducted by BuildingSMART International. In this survey, more than 70 % of the 250 organisations surveyed indicated that the greatest benefits of BIM in projects are:

i) improved decision making,
ii) ii) improved quality and
iii) iii) improved or faster collaboration (buildingSMART, 2022).

OpenBIM is increasingly used in the construction industry worldwide, and many countries are adopting or working on it for their regulatory process,

The UK has become a leader in BIM implementation, largely thanks to government initiative. Since 2016, the public sector has required the application of BIM methodology, with specific information requirements being defined in public works procurement.

The Scandinavian countries are among the pioneers in the adoption of BIM, with Finland beginning to use the methodology in 2002, and in 2007 there was a mandate from the confederation of the Finnish construction industry to impose the use of IFC, and they decided to do it from 2024.

In Denmark, public procurement also requires BIM methodology.

In Germany, the government has set up an initiative, consisting of several AEC organisations, to develop a national strategy for the implementation of BIM, aiming for a 2020 target for implementation in all infrastructure projects.

In 2015 the French government created the Plan de Transition Numérique dans le Bâtiment, which defined a national strategic plan for the implementation of BIM. Also in Spain, a mandate has been created for public sector projects to use BIM in 2018, and the deadline for application to infrastructure projects has been extended to July 2019.

Also in Asian countries such as Singapore, China and South Korea and Dubai , BIM has been widely disseminated and supported through the development of standardisation and the publication of public mandates. It is relevant to point out that, at international level, there are already initiatives focused on the application of BIM at local authority level, with various levels of depth. There is particular emphasis on the building permit component, with examples from Singapore, Dubai, and Denmark (case of the Municipality of Gentofte).

In the particular case of Singapore, the BIM- based CORENET submission system (IFC) even allows the application of automatic regulatory compliance checking algorithms, speeding up processes and minimising errors.

In Portugal there is a government mandate for BIM adoption for the issuing of digital building permits, with first results in some municipalities being expected in January 2027, whereas general country-wide adoption has been defineed for January 2030. A unique front-end platform for all building permits is expected (regarding of the municipality of concern) with automated checks being made based on IFC files. The

(graphs with countries and use of OpenBIM in regulatory)

Create a map highlighting countries with "well known" advanced G4R activities (Estonia, Finland etc.), and a list/graph) with sites runnig published g4r activities (including cities like Santiago, Lappeenranta, Geneva etc.)

3.1.2 Standards, why neutrality and openness are a must

…..

[MA] First of all, most of the requirements laid out by government agencies or municipalities are software independent. It is frequent to see requests being done in open standards, such as PDF, with definitions made by the corresponding ISO Standard (ISO 32000). Therefore, whenever a public office requires a PDF file, there is a guarantee that any stakeholder can use any software (free or not) to produce the PDF, which in turn can be opened and checked in any PDF reader/writer software. The use of this type of neutral format is very important to ensure a proper market functioning in terms of freedom of competition amongst software companies. The opposite picture of requiring a specific proprietary format could have catastrophic consequences, leaving governments/countries in the hands of a software company that could at some point raise prices with no valid justification, or fail do develop an important feature for proper functioning of public processes. The well documented 'vendor lock-in' situation, as described above, can have catastrophic consequences, and should be avoided at the root of implementation of any process. At a similar level, the software being used by public offices themselves can suffer from vendor lock-in problems. It is precisely for that reason that many governments worldwide have shifted towards Linux rather than Microsoft (avoiding fees and dependence on a private company). This is however a more complex matter outside the scope of data formats, which is not to be debated further in this document.

In what concerns to BIM, the format that satisfies the neutrality and openness requirements above is the IFC, which is managed by buildingSMART and keeps being updated in ISO 16739. The IFC is a complex data format created for BIM that encompasses very important features that make it capable within the context of AECO industry. The certification program of buildingSMART ensures predictability for all stakeholders by certifying the capacity of software solutions to import and export IFC according to predefined subsets of information (the MVD's). The state of software certification can be seen in https://www.buildingsmart.org/compliance/software-certification/certified-software/ . It is further noted that IFC versions progress, but backwards compatibility is being guaranteed by buildingSMART: this means that contemporaty software for opening/using IFC version 4.1 is able to open whichever previous versions of IFC existed (e.g. 1.0, 2x3, etc). These are very important matters for archiving for example, in which it is known that we do not depend on having an old version of a software to be able to open an old file. In view of this archiving aspect, it is interesting also to pinpoint that some countries such as Norway have already appointed the IFC format as the format of election for National Archiving of object-based building information models (BIM) (see https://lovdata.no/dokument/SF/forskrift/2017-12-19-2286).

As seen above, the use of IFC does not seem to have any competition, and it fulfills the need for openness. At its current stage of maturity, LV] IFC is a stable platform. Regulators can use this reliably, because the structure and order the scheme provides, and prepare them for the automatic checking. A prior diagnosis and planning is necessary, understanding Roles, processes, and then concatenating the various standards such as Classification standards, model standards, national standards, international standards, everything must be correctly implemented and prepared before the implementation of the Regulatory processes. Without quality and standardized models, regulatory processes will be complicated. Parameters subject to verification must be defined one by one. The success of the regulatory process begins with a good product. Automated checks enhance data, models and buildings quality. Therefore, it must be understood by regulators and permit issuing entities that the information requirements need to be set for automated checks to occur in BIM. Therefore, a IFC model uploaded by an architect for a permit shall endure a verification of conformity of submitted data (e.g. is it correctly geo-referenced; do the floor names follow a nomenclature fixed by the municipality) before they can actually be checked for local law. Therefore, regulators and issue-permitting entities will need to be aware of methodologies such as the 'Level of Information Need' (EN17412 of European reach, now being upgraded to ISO 7817 for global reach), as well as the "Information Delivery Specification" for quick checking of data submission (https://technical.buildingsmart.org/projects/information-delivery-specification-ids/). Then, the automated checking software/platform to be used can be deployed for the necessary checks (before legal checks, there can also be 'consistency checks' such as looking at the property "area" of a Room and checking whether the declared 16m2 matches the actual space of the room: indeed checking can go this far, as to allow very little room for human error, or even fraud).

3.1.3 OpenBIM and infrastructures

The use of OpenBIM for infrastructures modelling hase been extended from builidngs to infrastructures in the last XX (10?) years.

The improving of the standard to be suitable for this essential category of built assets accelerated fast with the development of models for railways (released in XXXX) while definitive models for roads, tunnels and port and waterways are still under construction.

Infrastructure digital models' features are included in the most recent IFC standard versions

Accordingly, there is not yet an actual digital process example for approval of built infrastructures, but in many countries there is a strong will to adopt this process asap, especially because in this environment the benefits from a standardized digital procedure will be enormous, as recognized by the EU, that is suggesting the using of OpenBIM as a support to public procurement

https://public-buyers-community.ec.europa.eu/communities/bim-and-public-procurement

3.1.4 OpenBIM Interoperability and GIS data integration

FC ask to Tomi Henttinen (RIR) geolocation in BIM models (buildings)

Possibly start this chapter with a CS highlighting in it the chapter topic

4 Laws and regulations

4.1 Regulations, Requirements and Recommendations

Possibly start this chapter with a CS highlighting in it the chapter topic

4.1.1 RELEVANT LAWS AND REGULATIONS

4.1.2 DATA PROTECTION AND PRIVACY

The ISO19650-5 is a standard concerned with the security risks involved in dealing with information management within the built environment, especially across multiple organizations as it usually is the case with collaborative BIM. It is directed to ”*not only appointing parties and appointed parties, as defined in ISO 19650-1, but also demand-side organizations who are not directly involved in an appointment*”, as are regulators. It establishes a ”*security-minded approach can be applied throughout the lifecycle of an initiative, project, asset, product or service, whether planned or existing, where sensitive information is obtained, created, processed and/or stored.*" This approach involves assessment of the need for further information security measures and, if so, the establishment of a security strategy and subsequent security management plan. It is recommended regulators apply it when dealing with information submitted to them in the permitting process as well as be aware that organizations using their services may have a security-minded approach in place.

ISO, **ISO1950-5: Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modellin**g — Part 5: Security-minded approach to information management. 2020.

4.1.3 Possible Legal Topics/Details

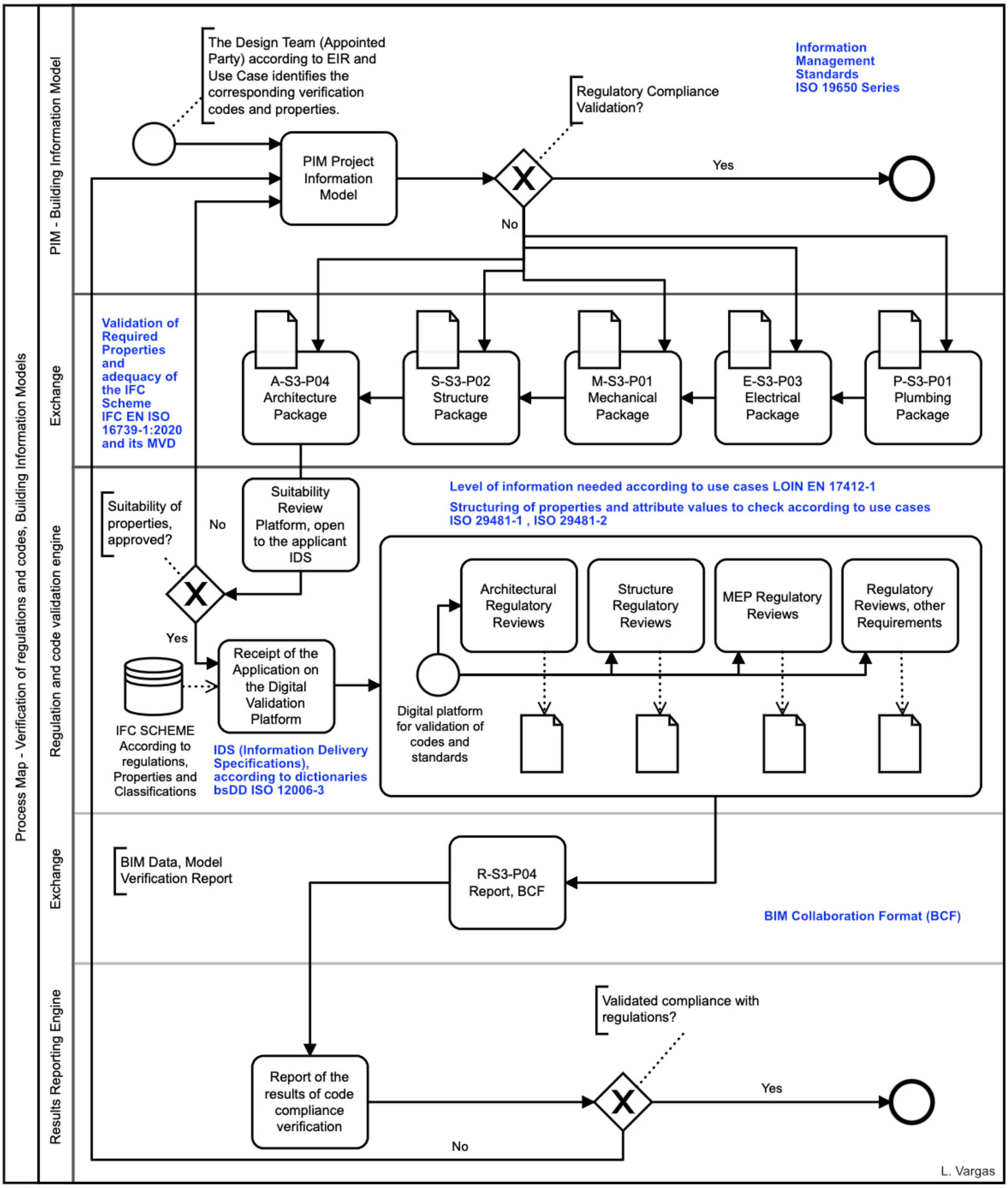
- INTELLECTUAL PROPERTY
- CONTRACTUAL ARRANGEMENTS
- LIABILITY AND DISPUTE RESOLUTION

5 Data and documents

5.1.1 Standards

Ask something RIR what is going on.

** put here a process description that explains WHY you need a a support, and link it to the standard used and reported and a little explained in the attachment. **



Steps and Standards - Exchange Information Requirements (ER) according to Use Case.

1- Defines the specification method for information requirements and context.

ISO 29481-1 Information Requirements (ER)

1.1 Defines business context of ER

ISO 19510 BPMN

ISO 29481-2 Interaction Map/Transaction Map

1.2 Mandates ER

ISO 19650-1 Information submission and management requirements.

1.3 Provides Terminology. Defines a language-independent data structure for data dictionaries.

ISO 12006-3 Data Dictionary (Schema) / bsDD

1.4 Formalizes ER

ISO 16739-1 IFC and its views (MVDs)

1.5 Stratifies/categorizes ER, defines the level and types of information requirements.

EN 17412-1 Level of Information Need.

Linking ER and other ISO standards

In order to strengthen the connection between ER (ISO 29481-1) and ISO 19650, include a clause in ISO 19650 which states that Information Requirements in ISO 19650 shall be specified according to ISO 29481-1.

In order to strengthen the connection between ER and ISO 12006-3 include a clause indicating that the basisSchema is the data dictionary (e.g. bSDD) defined according to ISO 12006-3.

A subschema (MVD) name of the data dictionary, if available.

The name of the referenced schema (e.g. bSDD defined according to ISO 12006-3)

The name of the element in the reference schema.

In order to strengthen the connection between ER (ISO 29481-1) and other standard data models (IFC, cityGML, MVD…)

Standard Data models and Sub-schemas should have information requirements specified in a formal language.

Specify IFC 4.0 pr cityGML, etc.. as the basisSchema, or you can map ER to both of them or other standards through the name of the referenced schema or MVD (e.g. IFC 4.0, cityGML, DCV, COBIE…). The name of the element in the reference schema (e.g. IfcDoor, IfcDoor.OverallHeigth, IfcBuildingElement>IfcDoor…)

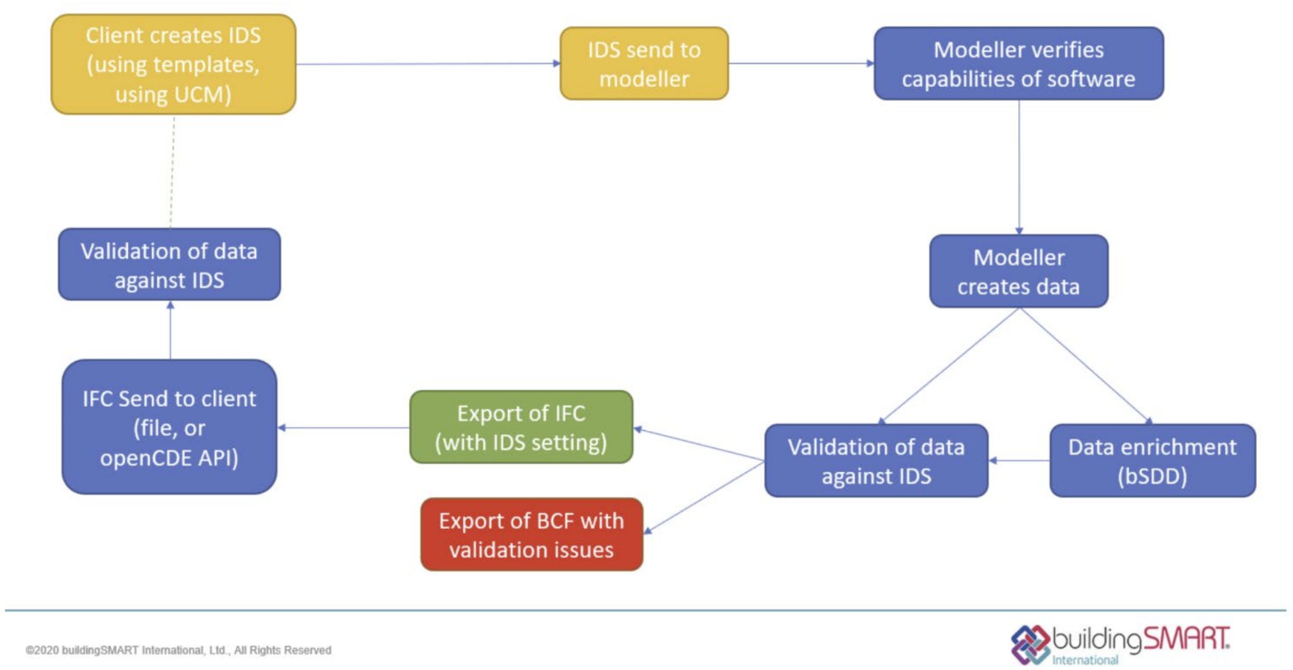
Tools:

https://www.bsi-ucm-en.info/

https://ucm.buildingsmart.org/

https://www.ukbimframework.org/standards/

IDS



The process starts with requirements

and ends with user guidelines. There are solutions that

address these aspects in a specific way, we refer to solutions such as IDM (Information Delivery Manual).

IDMs respond to these problems by proposing a methodology that captures business processes in projects, developing detailed user information exchange requirement specifications. The IDM consists of three parts:

1. The process maps
2. The exchange requirements
3. Functional parts and business rules.

The first step in the process of developing different IDM, and subsequent MVD, oriented to regulatory validation schemes, involves an efficient interpretation and application of the various standards related to the exchange of digital information and BIM to the processes inherent to each institution, processes that must be subject to and adjust to these new exchange schemes, including the information requirements of the coordination model or use cases, considering the flow of information, the granularity and the necessary level of definition at the various moments in which is required, much of the information obtained in one stage is a determining factor in subsequent ones, achieving traceability and pertinent registration are fundamental inputs in the process of achieving appropriate regulatory validation from IFC schemes

Possibly start this chapter with a CS highlighting in it the chapter topic

5.2 Security and reliability

(FC check in other businesses)

Regulatory on digital data in pharmaceuticals

Data security and reliability have been since the beginning (last century 80's and 90's) an essential issue in the transition of pharmaceutical regulatory to digital. Cybersecurity and digital data safety compliance in the pharmaceutical ecosystem are crucial to protect sensitive information, maintain the integrity of research and development efforts, ensure patient privacy, and prevent unauthorized access to critical systems. Regulatory bodies, such as the U.S. Food and Drug Administration (FDA) and the European Medicines Agency (EMA), have specific guidelines and requirements that pharmaceutical companies must adhere to.

In general, following the development of integrated portals for compliance data exchange, it has been commonly agreed that most of the security problems must be delegate to the digital infrastructures manging data. Unfortunately, in the early 2000 most of the digital commercial platforms were not suitable to support the strict security and reliability requirements peculiar to this industry. This changed time after time, and during the last years, more compliant infrastructures are available, even though data leaks are still something regulatory and industry are fighting against.

An example of solution adopted in EU (which has EMA, a unique EU federal pharma regulatory agency for 27 countries) to support pharma data security and safety peculiarities has led to release of federal mandatory data platforms to be used for data collection and exchange. (Like IRIS (Interactive Regulatory Information System) or CTIS (Clinical Trials Information System)) in which security features are centrally managed by the agency itself.

Aerospace Data compliance

The topic is widely considered a main priority in this regulate industry too. Because secrecy is an essential defence topic, there is not a wide use of shared platform in this ecosystem, so security is mainly regulated in independent systems through norms and guidelines. There are various aerospace-specific standards that address cybersecurity and data safety. One example is the Aerospace Standard AS/EN 9100, which includes requirements for information security and cybersecurity within the aerospace quality management system.

In USA Two specific sets of guidelines apply to aerospace and defense companies: NIST SP 800-171 and NAS9933, similar initiatives has been launched by EASA and other countries aerospace agencies.

In both ecosystem general regulatory ask for specific security and safety digital protection practices in each software that is using sensible data, and validation programs and routines to challenge and document the applications testing.

See ISO 19650 part 5

Possibly start this chapter with a CS highlighting in it the chapter topic

5.2.1 Data environment and archiving

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5.2.2 Automatic checking

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Automatic checking is not at all a new subject, at least from the conceptual point of view. Indeed, research on this matter precedes the era of BIM as a generalized methodology. With the introduction of BIM mandates for public tendering in several countries of the world, the focus on IFC as a vendor-neutral format has come into place, as expected. The same goes for automatic checking. Therefore, even though models are created in proprietary software with means for self-checking in many aspects, the export to IFC is a fundamental step, as all relevant information must be passed to the IFC file in proper conditions as per the requirements of the public office receiving the file for tendering of for permitting. Much has been done in terms of IFC-based verification of rules, and establishment of software companies able to provide these services customized to governments. There are also many open-source initiatives going on that allow IFC to be queried by in-house code, and even code-checking software shared online in platforms such as github. It is however remarked that the main challenge in automatic checking does not reside in the technological aspect of BIM-IFC, or even the capacity to encode rules into automatic (or semi-automatic) IFC-verificators. The main difficulty/challenge seems to reside in the need to modernize an ecosystem of municipal rules that are often unique to each municipality (hence making it impossible for establishment of nation-wide platforms) and the tendency of most regulations to focus on paper-based verifications, which are anachronic and hard to implement in a world of digital models. Also, it is worth mentioning that a verification of compliance for a building permit is normally involving many different regulations that almost need to be 'cherry-picked' on a per-case-basis within an intricate connection between BIM and GIS, for the applicable restrictions and regulations.

All of the above end up demanding careful integration work in multiple fronts for the integration of digital building permits. There are however multiple initiatives and examples *that are helping to pave the way and shed light on those willing to implement digital building permits. These can definitely be helpful for inspirations and even partnerships:*

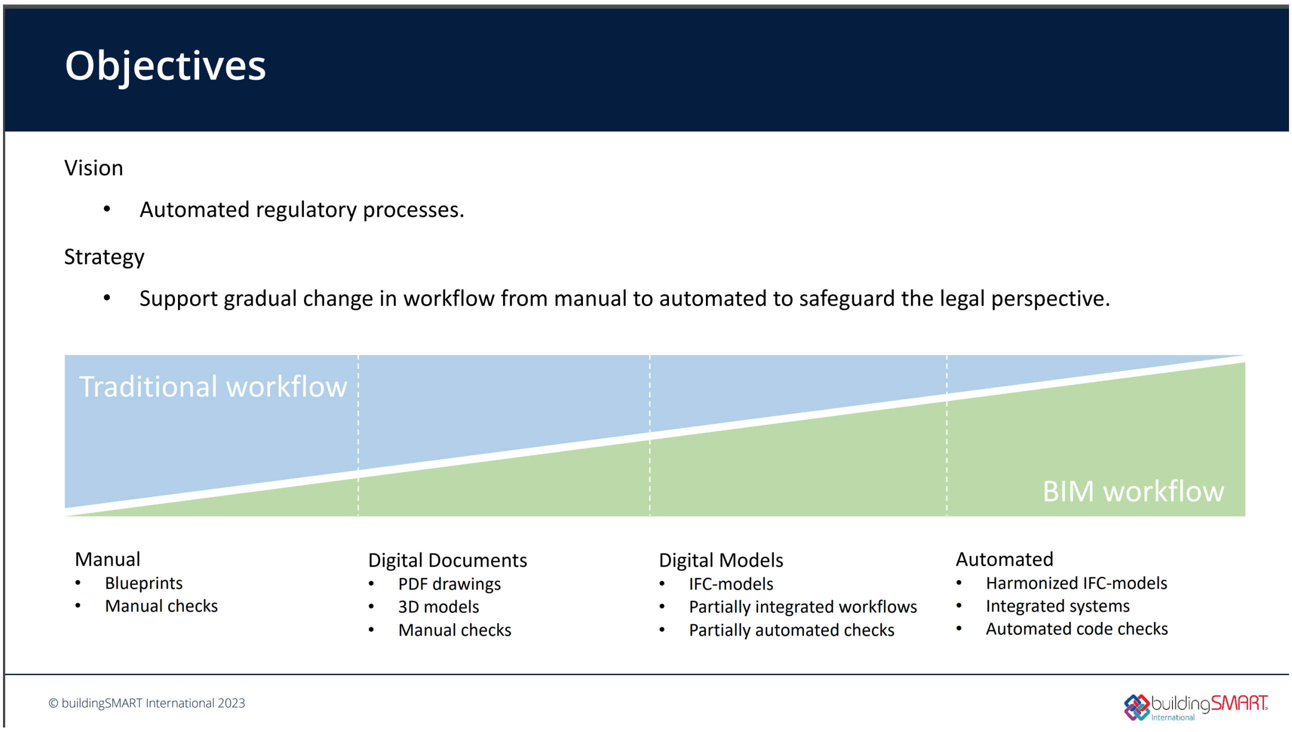
- *The European network for Digital Building Permits:* https://eu4dbp.net/
- *The three EU projects targeted for digital building permits, which have started in late 2021 and operate for ~3 years: CHEK (*https://chekdbp.eu/*), the ACCORD project (*https://accordproject.eu/*), the DigiChecks project (*https://digichecks.eu/*)*
- *The example of the Canton of Geneva (https://www.ge.ch/dossier/geneve-numerique/amenagement-du-territoire-heure-du-numerique/bim-building-information-modeling)*
- *The implementation in Finland....*
- *Rotterdam...*
- *South Korea*
- *Singapore*
- *Dubai*

Miguel Azenha can volunteer to work here

6

7 The Regulatory process transformation and the role of OpenBIM

7.1.1 Change management



Possibly start this chapter with a CS highlighting in it the chapter topic

➔ Eduardo will put some text here regarding the need for making regulations "objective" removing or changing subjective requirements which are difficult or impossible to implement in automated code checking (see Eastman and see Mainardi).

Relations with Industry

There are different approaches to the implementation of digital processes of digital information exchange and BIM, these are key to the development of regulatory processes. In Europe there is a consensus through the different standards that the European Union is committed to follow, in this aspect the CEN (European Committee for Standardization) has developed and carries out different standardization processes, in many cases linked to ISO Standards. CEN/TC 442 - BUILDING INFORMATION MODELLING (BIM), aims at Standardization in the field of structured semantic life-cycle information for the built environment. The committee will develop 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. In the United States different institutions have developed specific standards according to their specialty, the NBIMS has tried to consolidate a national standard developing to date 3 versions, "the challenge is a proliferation of standards and requirements throughout the industry. Many owners, federal, state, and private, have developed their own BIM standards documents with variations between them". NBIMS states that, "Since its publication in 2015, however, many have had concerns about the challenges of referencing this content directly within a contract. Also, we recognize that as it is today, NBIMS-US Version 3 is not comprehensive, but a collection of useful material that can be individually implemented and referenced", so it will launch NBIMS Version 4, where these challenges will be addressed.

There are 2 main groups of standards, Information management standards and Information exchange standards, each country has international standards, national standards and program or project requirements. Regarding international standards and information management standards there is a general consensus on the application of the ISO 19650 series with their respective country annexes, as for the international standards of Information exchange standards, the BuildingSmart intl. standards are generally followed, each country has its national standards increasingly linked to these 2 groups of international standards, there are also standards linked to specific programs or projects per country, such as contract requirements, customer requirements, federal requirements and other public or private requirements.

In Latin America in general, information management standards are implemented according to ISO 19650, in different countries several ISO standards created by BuildingSmart related to Information exchange have also been approved. PlanBIM of Chile has supported different countries in the implementation of digitization and BIM processes, and is a reference in terms of the application of ISO 19650 and the structuring achieved in terms of use cases and information level, among others. The BIM Forums (initiatives generally linked to the construction chambers of each country) are organized at the regional level by the Inter-American Federation of the Construction Industry and promote private initiatives and support governments. There is also the BIM Network of Latin American Governments that share and promote initiatives at the governmental level in the region.

7.1.2

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7.1.3 Training and support

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Will all people involved in digital building permits need to become experts in BIM? The answer is NO. In fact, the quantity of expertise fields in BIM is so wide that there would be a very limited number of people (or even none at all) in the world with experience in all relevant fields of application of BIM. Those involved in the side of the permit-issuing will of course need some basic training in BIM, as to understand the process as a whole (e.g. the intricacies of IFC, IDS, etc). This kind of training is already certified by buildingSMART with the foundation level (see details in https://education.buildingsmart.org/). This level of training/certification only requires circa 20h training (which may even be taken totally/partially online), and it offers the needed transversal knowledge to understand the processes as a whole. Additional training is also necessary in order to master the platform/software to use for model-checking. This part needs to be delivered by the supplier of the platform/software and has a very much practical side, rather than handling new complex concepts. This additional training could be as small as 20h as well, providing the capacity to use.

Of course, from the side of practitioners (Architechts, Engineers, etc) submitting processes for the building permits to be issued, training is also necessary. However the training needed for the submittal to building permit is not more than the training one would need for working properly in BIM. In many countries, this is already happening due to BIM public procurement mandates. As BIM becomes mandatory in public procurement, several necessary steps are being taken towards the country-wide capacitation of AECO stakeholders. This kind of training/capacitation is considered out of scope of the present document.

8 Conclusion

9 Technology Details

9.1 Documents and links to go in the deep

9.2 Glossary