Support of the digitalisation of the built environment, public procurement and SMEs in construction

October 2023

Digital building permits toolkit for building public authorities

Prepared for the European Commission

European Commission

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Acronyms list

Acronym	Description
BIM (Building Information Modelling)	BIM is a digital form of construction and asset operations. It brings together technology, process improvements and digital information to radically improve client and project outcomes and asset operations. BIM is a strategic enabler for improving decision making for both buildings and public infrastructure assets across the whole lifecycle. It applies to new build projects; and crucially, BIM supports the renovation, refurbishment and maintenance of the built environment – the largest share of the sector
openBIM	openBIM extends the benefits of BIM (Building Information Modelling) by improving the accessibility, usability, management and sustainability of digital data in the built asset industry. At its core, openBIM is a collaborative process that is vendor neutral. openBIM processes can be defined as sharable project information that supports seamless collaboration for all project participants. openBIM facilitates interoperability to benefit projects and assets throughout their lifecycle.
BCF (BIM Collaborative Format)	BCF allows different BIM applications to communicate model-based issues with each other by leveraging IFC data that have been previously shared among project collaborators. BCF was created for facilitating open communications and improving IFC-based processes to more readily identify and exchange model-based issues between BIM software tools, bypassing proprietary formats and workflows
IFC (Industry Foundation Classes)	IFC is a standardized, digital description of the built asset industry. It is an open international standard and promotes vendor-neutral, or agnostic, and usable capabilities across a wide range of hardware devices, software platforms, and interfaces for many different use cases

Why and how to use this toolkit

The European Commission's approach to digital building permits

- The European Commission – and it Executive Agencies – are actively involved in fostering the construction sector of the European Union, with a number of policy initiatives and resources (the main ones can accessed in the section **Library and useful resources**)
- Fostering digitalisation and digital building permits is part of the European Commission's vision of a more resilient, innovative and sustainable construction sector, reflected in the transition pathway for the construction a green, digital and resilient construction ecosystem, part of the EU Industrial Strategy
- When it comes to digital building permits, the initiative of the European Commission is not to impose a top-down approach, but to foster a vision through policy priorities and general tools. This allows Member States to adopt their policy initiatives with the pace and methods that better suit them, recognizing the specificities of national regulatory frameworks and digital maturity
- This toolkit aims at serving this approach

The proposed toolkit aims to help municipalities in their journey of digitalisation of their building permit system

Target audience

1. Building public authorities at municipal level (but also central level, if there is interest) aimed at digitalizing and automating the building permit system
2. Mainly municipalities with low/medium levels of Digital Permit System maturity (equivalent to the use a paper-based or 2D “digital paper” system)

Objectives

1. Make building authorities understand **what is a digital building permit system,** what are the different levels of maturity and what is **their current level of maturity**
2. Understand **the expected benefits** for the different stakeholders
3. Show what the **frontrunners** in this field are doing in the EU and outside
4. Laying the **foundations for the digitalisation of the building permit system**, such as having a clear roadmap, political commitment, collaborate internationally, manage the change internally (municipality’s staff) and externally (citizens) by providing training and communication material, etc.
5. Touch upon some of the **technical aspects** of the digitalization, such as making regulations machine readable for automatic compliance check

Content

The toolkit is composed of presentations, good practices and videos, structured in four modules. The content of each module is presented in the next slide

The toolkit is divided into five independent modules

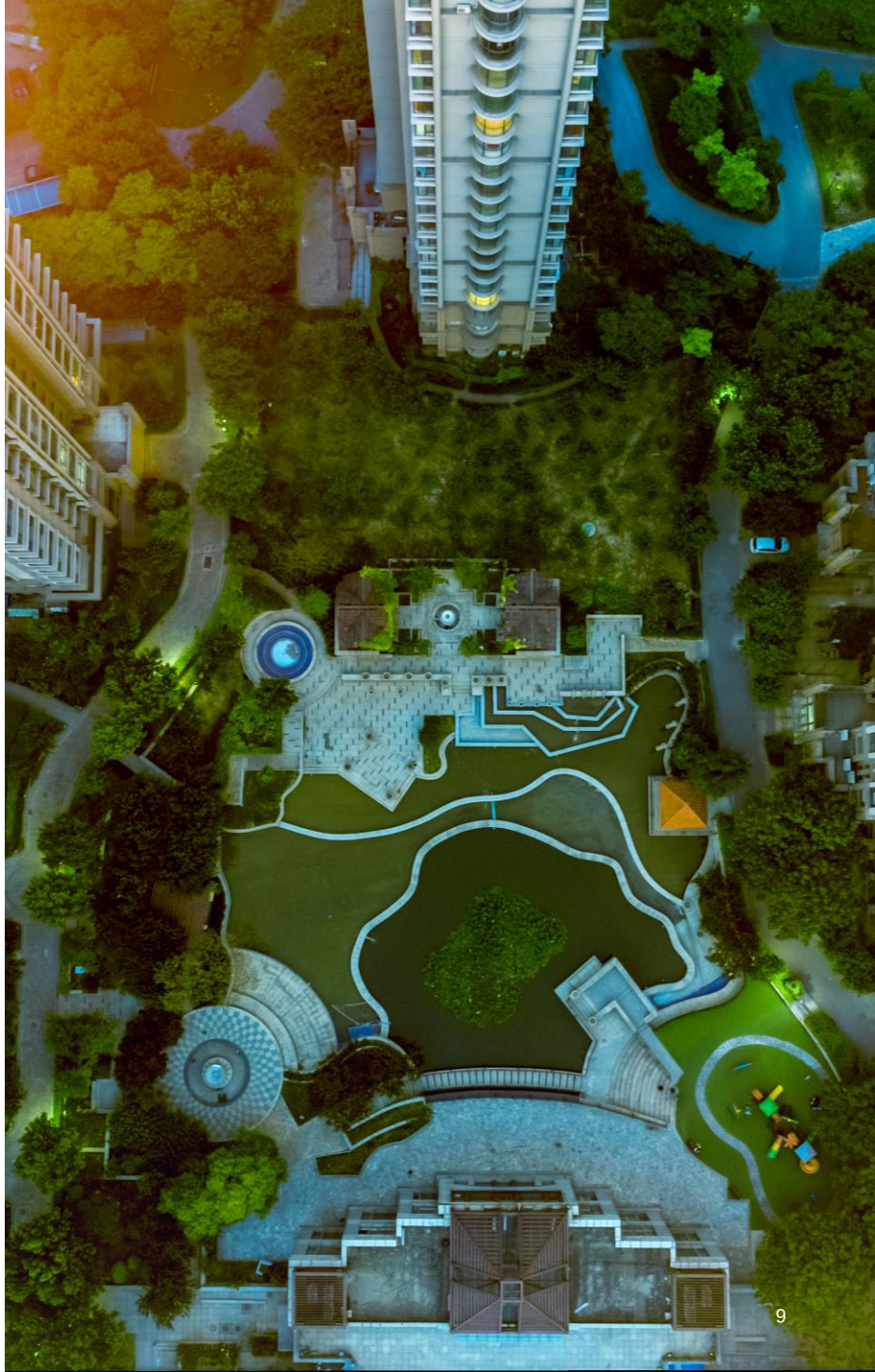
Click on the icon to go directly to the related module

Module	Objectives	Content
 **1. Stages of digital maturity of building permit systems.**	Understand the maturity stages of a digital building permit system	Although there is no established definition of what a digital building permit is, this module proposes a categorisation of the digital maturity of building permit systems. This helps the municipalities to understand the current level of digitalisation of their building permit systems and to consider the possible evolution. It also presents the results of the survey conducted to assess this level of maturity.
 **2. Benefits and costs of a digital building permit system**	Understand the expected benefits and costs of a digital building permit system, to create awareness	Brief explanation of the advantages of a digital building permit system, in terms of time and cost savings Benchmark of European and international costs and investments needed to digitalise the building permit system
 **3. Lessons learnt and best practices from frontrunners**	Be inspired by good practices	Learn from the good practices of the international frontrunners (Dubai, Singapore, Hong Kong, Norway, State of Geneva, Peru, UK and South Korea) and the EU frontrunners (Tallinn, Hamburg, Rotterdam, Helsinki, Vantaa, Vienna and Madrid), offering insights on their permit systems, an the lessons learnt from their digitalisation experience
 **4. How to get started? Step-by-step guidelines to start digitalising your building permit system**	Get guided through the steps needed to start digitalizing your building permit system	Summary of the key recommendations emerged from the analysis of the EU and international frontrunners, to provide practical tips to municipalities, including: • How to design a roadmap with clear milestones and SMART objectives • Identify the resources and vendors you need • Which materials (videos, FAQs, presentations) to provide to applicants • How to leverage partnerships with universities, research institutions, companies, software vendors, international organisations (builidingSMART), other cities • High-level guidelines to make regulations machine readable • Level-playing field: (i) how to include SMEs and (ii) avoid vendor lock-in

Module 1
Stages of digital maturity of building permit systems

Currently there is no established definition of what a digital building permit is

- A building permit is the final authorisation, granted by public authorities, that gives permission to start the construction phase of a building project. The related building permit process depends on many factors e.g. European/national/regional/local regulations, organisation of the municipalities, resources available
- There is currently no universally established framework defining the levels of digitalisation of building permit systems. However, based on current practices, the following four levels of digitalisation of building permits have been identified:
  - Level 1: **Paper-based**
  - Level 2: **Digital paper: 2D digital data**
  - Level 3: **Digital BIM-based process**
  - Level 4: **Digital BIM-based process with GIS**
- The following slides further detail the level of maturity, to guide the reader in understanding what a digital building permit could be
- In addition, the results of a survey recently conducted are presented to assess the level of adoption of digital building permits in the EU



What are the main process steps of building permits?

- Each building permit process might differ from one country/municipality to another
- However, for the purposes of this analysis, we have defined the main steps that are part of a building permit process and should somehow apply to any jurisdictions
- The levels of digital maturity of the building permit systems have been translated against these steps.

1 — Gather information on the building permit process

The applicant:
- Gets information of the building permit process in order to have a full understanding on what it entails and how to prepare for it

2 — Collect necessary data and submit the request

The applicant:
- Identifies him/herself and the nature of the permit's request
- Collects and fills in the required information (not including the drawings)
- Provides the drawing/model for the building permit (Planning, Construction)
- Asks questions to the municipality about the submission
- Submits the forms and drawings
- Pays applicable fees to request the permit

3 — Check the eligibility of the building permit request

The municipality:
- Checks the building permit request against the applicable rules and regulations of the specific municipality
- If needed, asks questions/ask for more information to the applicant about the permit/building, including a land/construction site inspection

4 — Grant or reject the building permit

The municipality:
- Shares the final decision (granted or rejected) to the applicant
- Sends the permit to the applicant, if granted

○ ○ ○ — Other steps

The applicant:
- Manages any change request from the municipality
- Appeals the rejected permit

The format of the drawings defines the level of digitalisation of the system as a whole

Each step of the building permit process may have different levels of digitalisation, based on the technologies they use. However, not all the steps are equally important to define the digitalisation of the whole process.

Thus, the question is **"what makes a digital building permit, digital?"**, or, in other words, what makes a certain municipality's permit system fall under level 1,2,3 or 4 in the proposed classification?

For the purposes of this work, it has been decided that the **format in which the municipality accepts the drawings ultimately defines how digitalised is the whole process**:

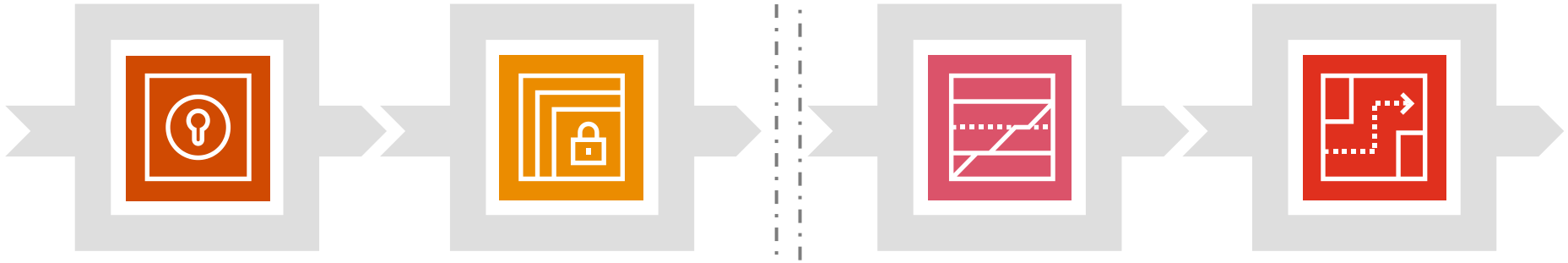
- If a municipality accepts only – or mainly – paper drawings → Level 1
- If a municipality accepts only – or mainly – 2D drawings/scans via pdf; 2D or 3D designed software → Level 2
- If a municipality accepts only – or mainly – BIM models as drawings → Level 3
- If a municipality accepts only – or mainly – BIM models with GIS integration → Level 4

Other steps offer useful insights on other related aspects of the digitalisation of the building permit process, especially, step 2: *Collect and fill in the required information (not including the drawings*), and step 3: *Check the request against the applicable regulations*. However, the main step, automatically provides the municipality's digital maturity of building permit system

Overview of the four levels of digital maturity of building permits systems

Paper-based or PDFs/online application; 2D; no interoperable data

Digital interoperable data; 3D model; can include GIS; can include automatic checks via AI



Level 1

Paper-based

- Submission of physical paper documents, manually reviewed by the municipality
- A website may be available with information to start the procedure is still paper based

Level 2

Digital paper: 2D digital data

- The building or renovation permission can be obtained submitting 2D documents electronic form
- The process is managed electronically but compliance checks are done manually

Level 3

Digital BIM based process

- The building permission procedure can be performed submitting a BIM 3D model
- Automatic compliance check may be available

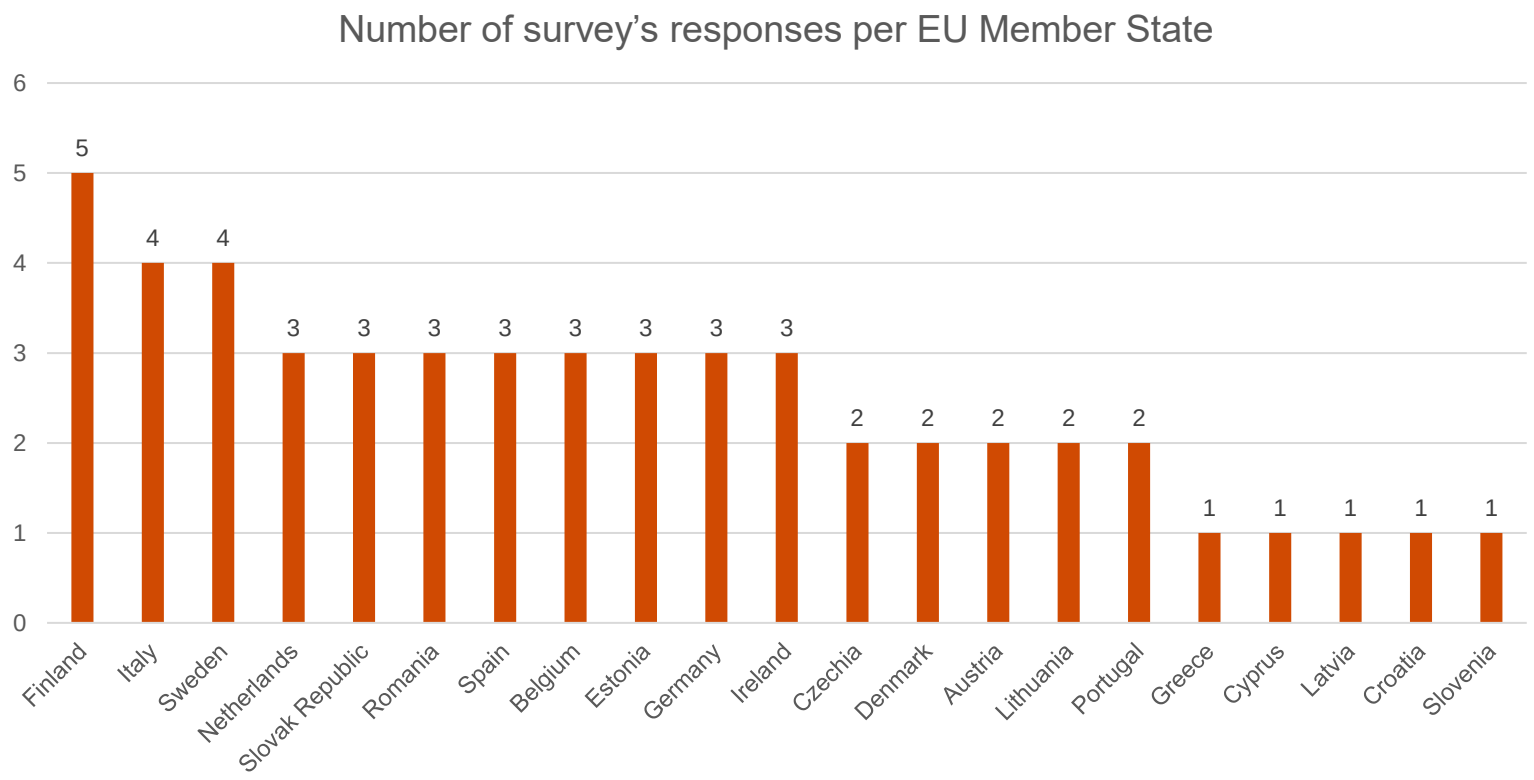
Level 4

Digital BIM based process with GIS

- The building permission procedure includes fully the use of BIM, integrated in GIS (GeoBIM)
- It allows automatic checks of the 3D building model and its surroundings

A survey to assess the level of digitalisation of the building permit system across EU municipalities was conducted

- Once the categorisation system has been defined, a survey and interview programme to map the level of digitalisation of building permits in the EU have been launched
- Prior to assessing the findings of the mapping exercise, it is important to provide an overview of the demographic information of the stakeholders consulted either via interviews or the survey programme
- The graph shows the survey's distribution of respondents per country
- Finland is the most represented country, with 5 respondents that took part in the mapping activities, followed by Italy and Sweden with 4 respondents
- On the other hand, in Croatia, Latvia, Cyprus, Greece, and Slovenia only one answer was collected
- Nevertheless, in Greece, Slovenia and Cyprus all the municipalities in the country follow the same building permit process, meaning that collecting one answer is sufficient to map the country
- The following slides will offer a brief overview of the results of this mapping exercise



12 municipalities are classified as level 1 of digital maturity of building permit system, still handling permit applications via paper

Paper-based application

Level 1 – Paper based

Main Characteristics	Other Characteristics
All documents, including drawings, are submitted in paper form. Authorities check the application against applicable regulations manually	Information on the process is available physically at the municipality's premises, or on some basic website Every interaction between the two parties is done in-person and/or letter The payment of the applicable fees of the permit is normally done at the municipality's premises or ATM transfer.

Insights from the survey

- Namur (Belgium), Augsburg (Germany), Prague (Czech Republic), Timisoara (Romania), Napoli (Italy) are examples of municipalities that are currently classified as level 1 of digital maturity.
- Among these municipalities, Paphos (Cyprus), and Bratislava (Slovak) only share information physically at the municipality's premises. Yet, Prague (Czech Republic), Kosic (Slovak), and Napoli, even though, are classified as level 1 of digital maturity, they only share information with applicants via a designated website. The remaining ones, provide both options to applicants.

This information was collected until October 2023

61% of EU's municipalities are classified as level 2 of digital maturity of the building permit system

PDFs/online application; 2D; no interoperable data

Level 2 – Digital paper: 2D digital data

Main Characteristics

Documents and data related to the application can be submitted online

The municipality accepts drawings created via 2D or 3D software programs, or Pdf files, or scans of physical drawings.

Authorities check the application against applicable regulations manually or partially automated

Other Characteristics

Applicants can gather, provide, and receive information and documents online

Every interaction between the two parties is done by email or phone

Insights from the survey

- The majority of EU's municipalities submit documentation (excluding the drawings/models of the building) as digital form/pdf.
- Amsterdam (Netherlands), Ghent (Belgium), Dublin (Ireland), Graz (Austria), and Athens (Greece) are examples of municipalities where applicants submit documentation (excluding the drawings/models of the building) via digital form/pdf.
- Fewer municipalities are already using 2D or 3D software programs to submit documentation, such Bilbao (Spain) and Venice (Italy).
- Most EU's municipalities do the checking of the permit manually, while a few are able to partially automate the process. Few examples are Aalborg (Denmark), Narva (Estonia, Plzen (Czech Republic), and Kaunas (Lithuania).

This information was collected until October 2023

6 municipalities within the EU are working towards the implementation of level 3 of digital maturity

Digital interoperable data; 3D model; can include automatic checks via AI

Level 3 – Digital BIM based process

Main Characteristics

Documents and data related to the application can be submitted online

Applicants submit a BIM model of their project Authorities check the application against applicable regulations automatically through BIM.

Other Characteristics

Applicants can use a Digital ID to register the request and dedicate digital folder is used to share and store documents.

Using BIM allows both parties to collaborate and communicate through the BCF (BIM Collaboration Format).

Insights from the survey

- Even though no municipality has yet, reached level 3 of digital maturity of building permit systems, there are 5 EU's frontrunners that are progressing towards a higher level of digitalisation, namely, Rotterdam (The Netherlands), Madrid (Spain), Vantaa and Helsinki (Finland), and Hamburg (Germany)
- These municipalities already have BIM prototypes and pilots in place with developments to allow applicants to submit BIM models and automatise the checking of the permit against the applicable regulations for the municipality itself.
- Hamburg, for example, already allows applicants to submit BIM models as part of the pilot, while Helsinki is working with the ministry of Finance and Environment to adapt the regulations in order to be machine readable, and consequently, automatically checked.

This information was collected until October 2023

Tallinn and Vienna are the most digitised municipalities within the EU

Digital interoperable data; 3D model; can include GIS; can include automatic checks via AI

Level 4 – Digital BIM based process with GIS

Main Characteristics

Documents and data related to the application can be submitted online

Applicants submit a BIM model of their project. The applicant can visualise its project in a 3D model of the surrounding environment, thanks to GIS integration

The application is checked against applicable regulations automatically through BIM complemented with GIS information

Other Characteristics

Applicants can progressively upload data and information about the request of a permit with automatic check.

To improve the applicant's experience, an AI Chatbot is available in the municipality's website to provide relevant answers to applicants

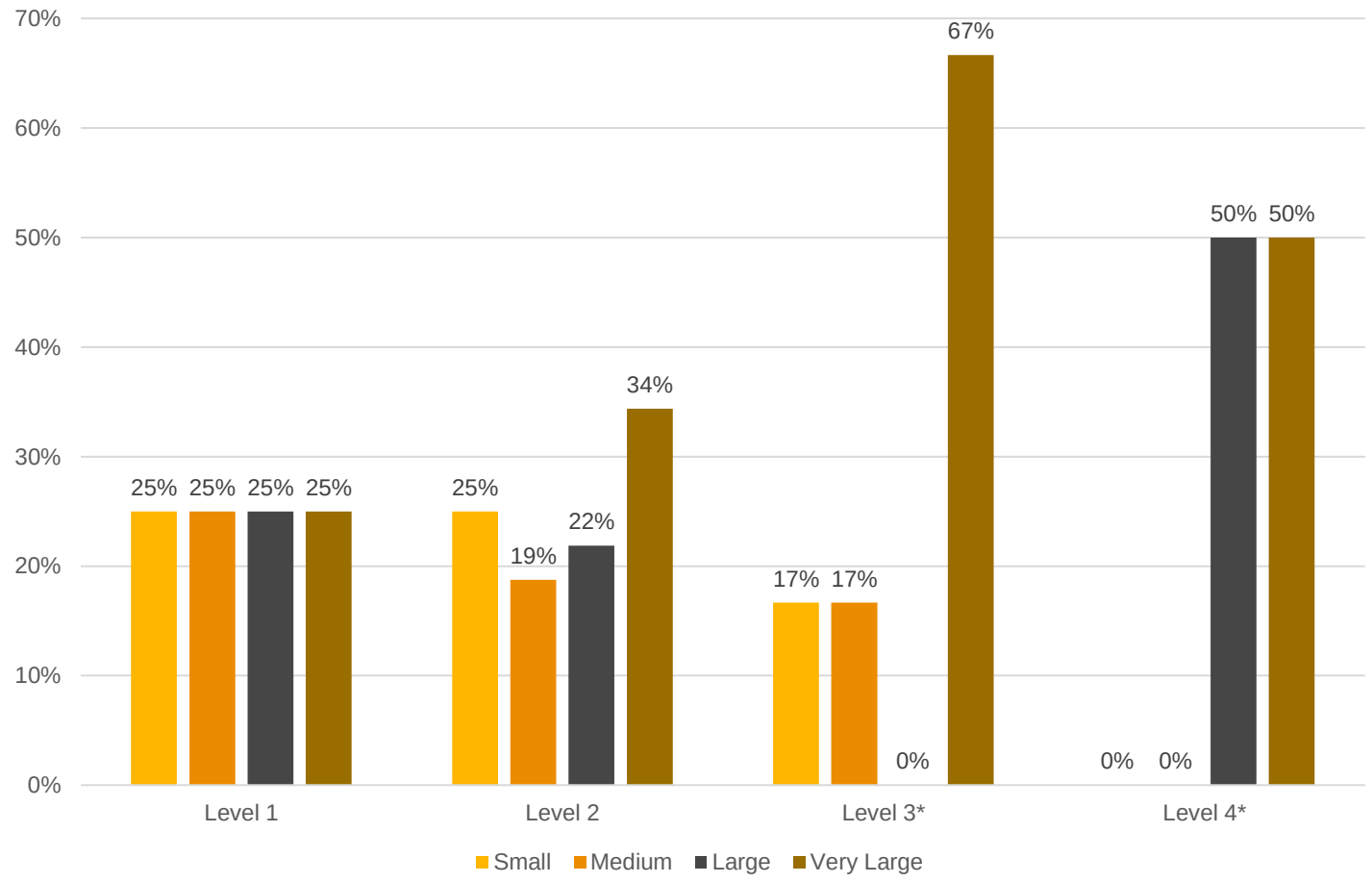
Insights from the survey

- Estonia is the most developed municipality by already integrating BIM in the building permit system. Vienna already has pilots on the development of BIM as well as GIS.
- Even though, level 4's features are not yet implemented, these municipalities are working towards GIS integration into the BIM system, which will allow applicants and municipalities to visualise not only the building but also the surroundings as it is possible to understand highly detailed geospatial context of the building. Consequently, it will enable stakeholders to make better-informed decisions to assess how the proposed building fits into the surrounding environment and what impact it would have on it.
- Furthermore, Vienna expects to be able to check automatically up to 85% of the regulations, while Tallinn will check around 20% of it.
- Vienna is still in the prototyping/pilot phase, while Tallinn expects to deliver this services to stakeholders still in 2023.

This information was collected until October 2023

Larger municipalities in the EU tend to have a more digitalised building permit process

- The graph shows the distribution of level of digital maturity of building permits, with the breakdown by size of municipalities.
- Results indicate that “Very Large” municipalities tend to be more digitalised, while “Small” and “Medium” municipalities are mostly classified as level 1 and 2.
- The reason behind this might be that large municipalities have **larger financial** and **technical resources**, and they might be more exposed to – and aware of – innovations happening in the local construction ecosystem, or internationally.
- The overall results of municipalities’ distribution by level of digital maturity are:
  - Level 1: 12 municipalities
  - Level 2: 32 municipalities
  - Level 3: 6 municipalities
  - Level 4: 2 municipalities



This information was collected until October 2023

The proposed categorisation of the digital maturity of building permit systems helps municipalities understanding the levels of maturity of digital building permit systems and their adoption in the EU.

Go to the next section “Module 2” to discover the benefits and costs of a digital building permit system

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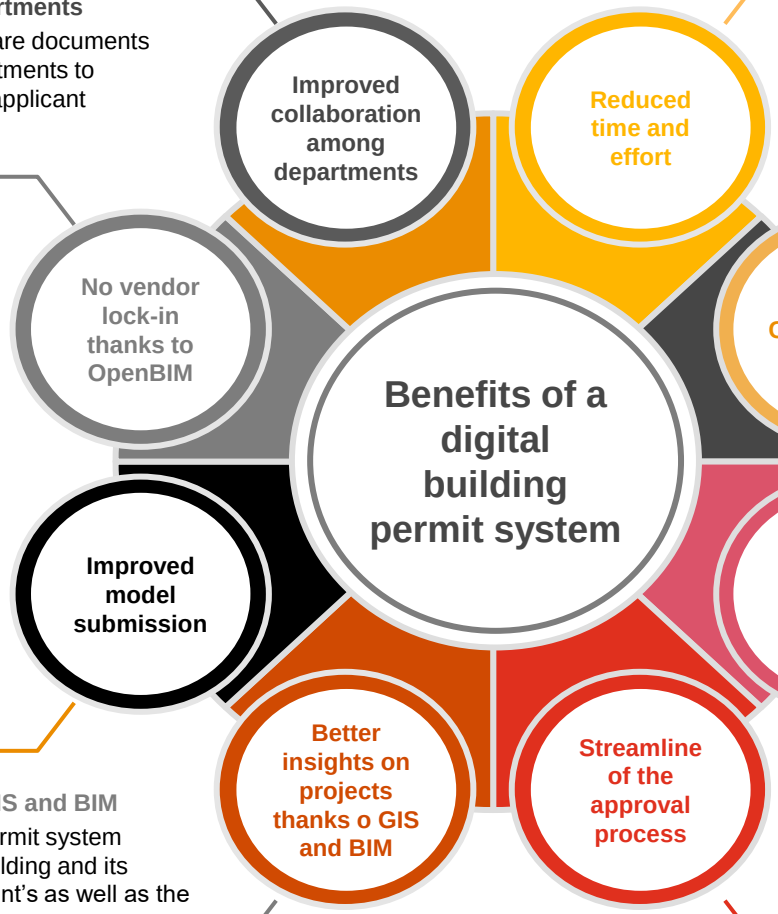
Module 2
Benefits and costs of a digital building permit system

The digitalisation of the building permit system brings several benefits to stakeholders



Improved collaboration among departments

Using a digital platform to store and share documents and BIM models, allows different departments to comment and provide feedback to the applicant

Reduced time and effort

The use of BIM brings efficiency to the building permit process, increases productivity and ensures more accurate outcomes. This leads to cost savings, and improved resources management

No vendor lock-in thanks to OpenBIM

OpenBIM promotes collaboration and interoperability in the construction and architecture industry, with IFC standards playing a central role in ensuring that BIM data can be shared and exchanged seamlessly between different software tools and organizations. In this way, users are not forced to purchase a specific BIM software.

Cost savings

The integration of BIM enables municipalities and applicants to reduce their costs. A few examples are: the time savings thanks to a more efficient permit application process; reduced paper & printing costs; a more efficient inspection process, by replacing in-person inspections with checks on the BIM model

Improved model submission

BIM provides a better visualisation, collaboration, and accuracy of the building details. Some of the key features are the possibility of using data in an interoperable way and revise the project

Better user experience

Providing a digital platform to the applicants enhances their user experience. Applicants benefit from a one-stop-shop where they can do all steps of the building permit process.

Better insights on projects thanks o GIS and BIM

BIM and GIS integrated in the building permit system provide detailed information about the building and its surroundings, which improves the applicant's as well as the municipality's decision making

Streamline of the approval process

BIM allows the municipality to automatically check the building permit against the applicable regulations. By translating the regulations into machine readable, part of the regulations are checked by the system immediately.

The implementation of a digital building system in Singapore led to financial savings and efficiency gains for the government and the construction industry

Construction industry benefits

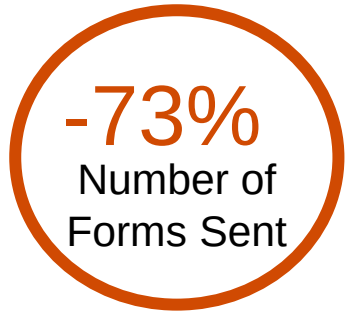
Annual Savings

The investment on a digital building system (originally without BIM), called Corenet, by the government of **Singapore**, not only helped to deliver an estimated annual savings of **USD 16m** to the government, businesses, and investors, but also contributed to the **Singapore's sustained growth in the construction sector**

Dispatching Savings

The government stated that the construction industry saved USD 20.4m in dispatching and printing costs between 2001 and 2013

Government benefits



Time Reduction

The initial digital building system launched in Singapore (Corenet 1.0 which does not incorporate BIM), enabled a 80% reduction in total time to issue construction permits/licenses

Number of Applications

The implementation of Corenet 1.0 in Singapore led to 73% reduction in number of application forms from 845 (physical) to 231 (electronic).

Source: https://www.jacic.or.jp/movie/jseminar/pdf/movie20191106_chan.pdf; https://www.nova-hub.com/e-government/

The BIM implementation in Estonia's building permits is expected to provide more than 500k in savings to the municipalities per year

- A BIM based permit system typically yields three kinds of savings:
  1. Time saved by the public authority thanks to a faster applications' review process
  2. Users' (contractors, architects) **time saved with a faster design process thanks to BIM**
  3. Time saved by both parties thanks to the **decrease of design flaws → any incompliance with regulations is detected earlier** instead of during the construction phase
- However, only the first type of time savings is quantifiable.
- Estonia estimated them starting from the average time spent processing permits (using data from the city of Tallinn) with the non-digital system
- Assuming a **55% time reduction** (estimation) **in the process thanks to the introduction of BIM,** and an average hourly wage of €11 in Estonia, the potential annual savings for the public authority are **€537,826**
- Savings are lower for simple buildings (**25%**) than for the complex buildings (**80%**), since the automatic compliance checks will be more helpful for the complex buildings.

Estonia	Average time spent (hr)	Average time saved (hr)	Average € saved per permit	# of permits in Estonia	€ saved per year in Estonia
Building Permit				6377	**€292,066.00**
Simple Building	7.3	1.1	€ 11.00	3316	€36,375.10
Complex Building	17.3	8	€ 83.50	3061	€255,690.90
Usage permit				5425	**€245,760.50**
Simple Building	7.4	1.1	€ 11.20	3107	€34,785.70
Complex Building	18.9	8.8	€ 91.00	2318	€210,974.80
Total Savings					**€537,826.50**

Disclaimer: Usage permit is another type of permit that is needed before the building can start being used. The usage permit is needed in order to be sure that the building has been constructed according to building regulations and all relevant construction documents (construction diaries, etc…) are correct.

Source: https://eehitus.ee/wp-content/uploads/2019/12/Final-report.pdf

Illustrative examples of the cost of digitalisation of the building permit system

	Municipality	Population	Total cost	Cost per citizen
	Rotterdam	0.6m	€600k	€0.96
	Singapore	5.5m	€24.6m	€4.4
	Estonia	1.3m	€750k	€0.58
	Hong Kong	7.4m	€25.8m	€3.5
	South Korea	51m	€24m	€0.5

- The cost of implementing a BIM-based permit system can vary significantly, depending on the jurisdiction and on the scope of digitalisation
- The cost per citizen gives a relative measure, but the implementation of a BIM based system has some fixed costs regardless of the size of the city
- Rotterdam has only a pilot for now; the full implementation might lead to extra costs

Disclaimer: The data indicated is purely indicative

The proposed analysis of benefits and costs of a digital building permit helps municipalities understanding the possible can gain by digitalising their permit system, as well as the necessary investment.

Go to the next section “Module 3” to get lessons learnt and practical insights from municipalities that can be considered as frontrunners in digital building permits, in the EU and outside the EU

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Module 3
Lessons learnt and best practices from frontrunners

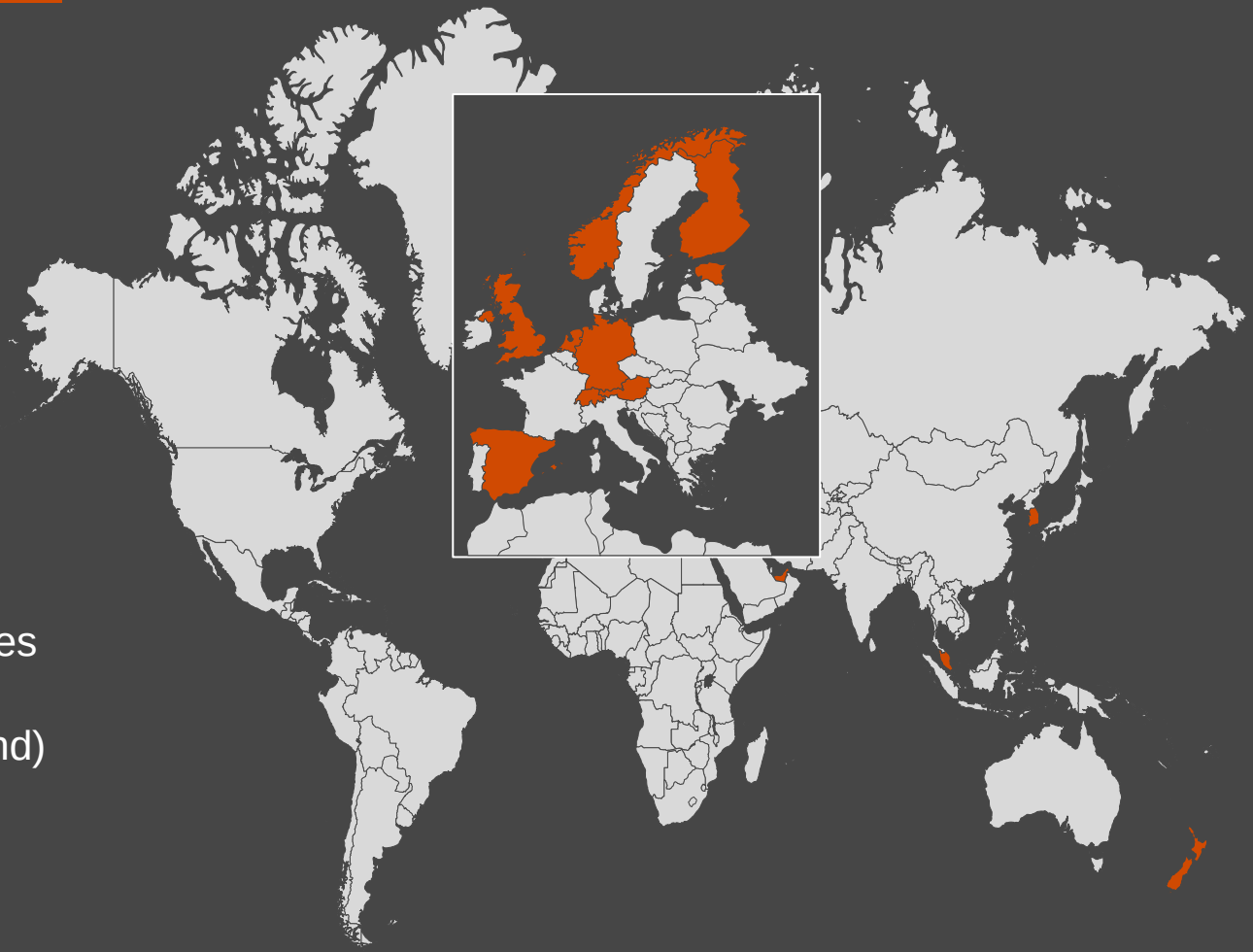
Who is leading the way in digital building permits in the EU and beyond?

EU Front runners

- Austria
- Germany
- Spain
- The Netherlands
- Finland
- Estonia

International Front runners

- Australia
- South Korea
- Hong Kong
- Singapore
- Malaysia
- United Arab Emirates
- Geneva (Switzerland)
- Norway
- United Kingdom



Best practices from EU frontrunners (1/5)

Government Support

The government support is crucial to enhance the digitalisation of the building permit system. For example, the Ministry of Finance and Environment in Finland is funding a project called RAV3PRO, which aims to adopt BIM in building permits across 33 municipalities in Finland.

The Ministry is playing an important role not only on funding the project, but as a project manager to ensure the developments are implemented by the municipalities.

Also, the government support to adapt the building permit regulation in order to be machine readable is key.

Electronic Platform

An electronic platform is the first step to digitise the building permit system.

The seven EU frontrunners have an electronic platform/webpage, where applicants can gather information about the process, collect and store the relevant documents, submit documents as well as the drawings/models of the building, and collaborate with the municipality.

Outsource BIM Software

Due to the lack of technological skills as well as BIM knowledge within municipalities, a few EU front-runners such as Tallinn, Helsinki, Vienna, and Vantaa, outsourced the implementation of the required BIM software, such as Solibri, or partnered with a company to develop it in-house.

Otherwise, developing a software from scratch with few resources could be very time-consuming as well as costly.

Collaborate with External Stakeholders

Partnering with expert organisations within building permits is crucial for its development. Tallinn highlighted that the partnership with Building SMART and Accord project was key to develop and integrate the openBIM and IFC standards.

Additionally, Vienna is collaborating with buildingSMART to implement international standards for BIM , and Madrid hired consultants to achieve a fully-fledged BIM-based building permit system.

Best practices from EU frontrunners (2/5)

Helsinki

3	Level of Digital Maturity of Building Permit System
54th	World Bank Doing Business Ranking

The municipality handles building permits through a e-platform hosted on a website, where applicants can submit documents and drawings in pdf files. Helsinki is doing a project called RAV3PRO to integrate BIM in the system.

Helsinki stated that its current challenges in the implementation of BIM, include:

- Lack of BIM knowledge among municipality employees
- The lower maturity level of smaller municipalities within the RAV3PRO project, and
- The need to change the municipality's processes and some degree of resistance to change from the staff

Lack of resources to build the BIM software internally led to outsourcing it to a private company.

Furthermore, the role of the Ministry of Finance and Environment has been crucial to foster the BIM adoption as well as collaboration on the adaptation of the requirements to enhance the BIM automated checking.

Hamburg

3	Level of Digital Maturity of Building Permit System
37th	World Bank Doing Business Ranking

Hamburg developed a dedicated platform to handle building permits, allowing applicants to submit drawings and documents in either paper or pdf format. The platform features a pdf checker that allows to automatically check certain parameters in the building projects.

Hamburg's building permit platform already provides the option to submit BIM models, even though, it is still in testing phase. The municipality is paving the way to adopt and implement BIM in building permits, and it expects to have a Proof of Concept by 2024.

The municipality highlighted as main challenges the adaptation of the regulations in machine readable format, to check building permits automatically, and the lack of expertise and awareness of digital technologies.

Best practices from EU frontrunners (3/5)

Rotterdam

3	Level of Digital Maturity of Building Permit System
103th	World Bank Doing Business Ranking

Rotterdam is working on implementing BIM in the building permit system. Until now, the municipality was able to implement a system to assist the current process. The system aims to facilitate the building permit process, comprising three essential components:

- A well-structured BIM model with specified standard requirements in IFC format,
- A geo-referencing integration to ensure compliance with Rotterdam's digital twin, and
- Adherence to building regulations outlined by the municipality.

Currently used in parallel with traditional 2D and PDF approaches, the system is designed to streamline permit processing, and there are plans to enable IFC model submissions for even quicker application processing. During the pilot phase, seven use cases were tested, including checking parameters such as the distance from fire exits and hydrants.

Vantaa

3	Level of Digital Maturity of Building Permit System
54th	World Bank Doing Business Ranking

Vantaa's municipality implemented a building permit system called Lupapiste, that was developed by Ministry of Environment to be used to send and receive applications, plans, and drawings in 3D format and provides a two-way communication channel between authorities and applicants. Currently, the municipality handles around 1,500 permits a year.

The Municipality of Vantaa is undergoing a transformation in its building control and permitting processes. They are shifting from a 3D model system to embrace BIM IFC open standards. This transition follows the success of the KIRA-digi prototyping project. Notably, the Building Control Department of Vantaa will accept BIM models in the IFC format. To enhance efficiency and accuracy, they have implemented a rule-based workflow for permit checking using a private company model checker. This system is expected to verify up to 70% of the necessary requirements, streamlining the approval process.

Best practices from EU frontrunners (4/5)

Madrid

3	Level of Digital Maturity of Building Permit System
93th	World Bank Doing Business Ranking

The municipality of Madrid provides a platform for applicants to submit digital documents and drawings (pdf format), called SLIM (Municipal Licensing System), and it developed another platform called SIGMA for Madrid municipality staff.

Currently, the Madrid's municipality is seeking to reach level 3 of digitalisation building permit system by incorporating BIM in the process. In 2020 and 2022, the municipality launched two pilots on the development of BIM to use 3D models for the verification of urban planning regulatory parameters. The pilots aimed at creating a collaborative BIM interface, with the automatic verification of the model against the applicable regulations in Madrid and, the creation of automatic building permit reports.

Developing its prototype, Madrid experienced challenges, such as insufficient pre-existing technological infrastructure to implement BIM, translation of the city's building regulations into a machine-readable language, and the training and adaptation of the municipality's staff to use BIM.

Vienna

4	Level of Digital Maturity of Building Permit System
60th	World Bank Doing Business Ranking

Currently, applicants submit documents and plans printed in paper form or as pdf via a web service. Additionally, the municipality is able to share the data and documents directly among departments via a system, called ELAK. Vienna already uses GIS in the current system in order to provide zoning regulations and facilitate evaluation and gathering information about the project

In 2019, the municipality started a beta phase on the further digitalisation of the building permit process. The research and development project BRISE-Vienna represents the beginning of level 4 of digitalisation of the building permit system.

The municipality's aim is to use BIM are:

- Better perception of the building structures and layout.
- Integration of GIS within BIM.
- Improve model submission, and
- Automatic compliance checking of projects against building regulations

Best practices from EU frontrunners (5/5)

Tallinn

4	Level of Digital Maturity of Building Permit System
23th	World Bank Doing Business Ranking

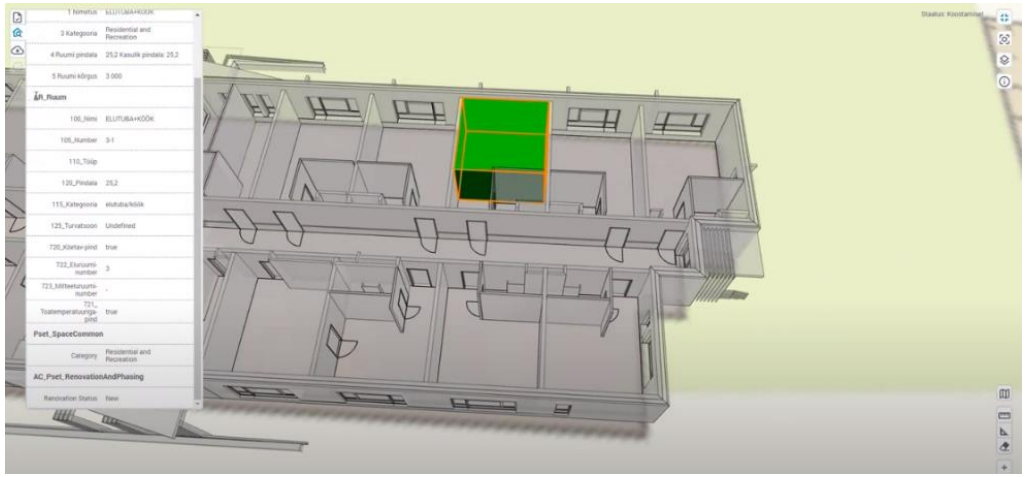
Tallin has been implementing BIM pilots since 2019. In that year, it launched a BIM-based permit system proof of concept, in 2021, it presented the MVP (minimum viable product), and in 2023 it is expected to fully integrate BIM within the existent building permit process.

The BIM-based system is expected to provide several benefits to stakeholders, such as:

- Increase in transparency of the process, allowing applicants to follow the steps of their building permit application through their user interface
- Faster review of the applications thanks to the automatic compliance checking.
- Increase the quality, detail and accuracy of the models, and
- It will be integrated in a web based and simple interface to allow applicants not specialised in BIM to be able to use the system.

Further, the BIM model will integrate GIS data and it will enable the automatic filling of information require about the building project, and lastly, the municipality provides BIM trainings and guidelines on how to submit a BIM project.

Demo of Tallinn BIM and GIS building permit system



Source: https://www.youtube.com/watch?v=XLLI2Av6930

Tallinn’s experience

Check the video below (Ctrl+click on the image) to watch a live demo of Tallinn’s BIM & GIS based building permit system

Image credits: GettyImages

Main takeaways from International frontrunners (1/2)

01

Electronic system to handle building permits

To develop a BIM-based permit system, it is crucial to start gradually. The frontrunners started digitalising their permit systems by establishing an **electronic system/platform/webpage dedicated to digital handling of building permits**. Such a platform allows for the electronic submission and management of building permit applications by both applicants and authorities, **thereby achieving a Level 2 of digital maturity**

02

The government needs to play an active role

The government is the main driver of numerous initiatives that lead to the developments and implementation of BIM, such as (1) **The creation of structured short-term and long-term roadmap** (i.e. a BIM roadmap) with a clear vision and objectives; (2) **Financial support**, in a twofold way: (2.1) Supporting financially the development of an electronic system incorporated with BIM to handle building permits; (2.2) Financing research and development in universities and private companies to develop cutting-edge BIM applications; (3) **Implementation of strategic policies to foster BIM adoption**, such as the mandate of BIM in public procurement processes.

03

Establishing strong international partnerships is crucial

The experience of international frontrunners shows that **partnering with external organisation plays a crucial role in the creation of a BIM-based building permit system**. For example, buildingSMART is a key player to support the digital transformation in construction sector as well as promoting and developing the use of BIM. buildingSMART helped to establish BIM with IFC open standards. Another successful example of partnership on BIM is the one between Peru and the United Kingdom. The Government of Peru is currently part of the United Kingdom Government Prosperity Fund and officials from the two countries work hand in hand to increase the adoption of BIM in Peru.

04

Provide financial incentives to adopt BIM

On the side of the authorities, each frontrunner case benefited from **direct government investments** to fund the BIM implementation project. On the applicant's side, the financial burden associated with the use of BIM software and hardware, along with the costs incurred for staff training, poses challenges. Countries such as Singapore, South Korea, and Malaysia have responded to this challenge by **instituting financial incentives aimed at incentivizing BIM adoption**.

Picture source: https://www.bimcommunity.com/experiences/load/191/a-new-bim-strategy-for-dubai

Main takeaways from International frontrunners (2/2)

05

Creating and making publicly available tools to support stakeholders in adopting BIM is very effective

In order to facilitate the adoption of a BIM-based permit system, governments and local authorities should provide stakeholders with: (1) **BIM standards and guidelines**: Document that defines the steps users must follow to develop BIM models. In addition, the document describes the necessary tools, templates, and practices required to develop a high-quality information model that can successfully be submitted in the BIM-based electronic system; (2) **Training videos**: free training videos available on the municipality's website (in the building permit application section), showing citizens how to use the digital system to apply for their building permit.

06

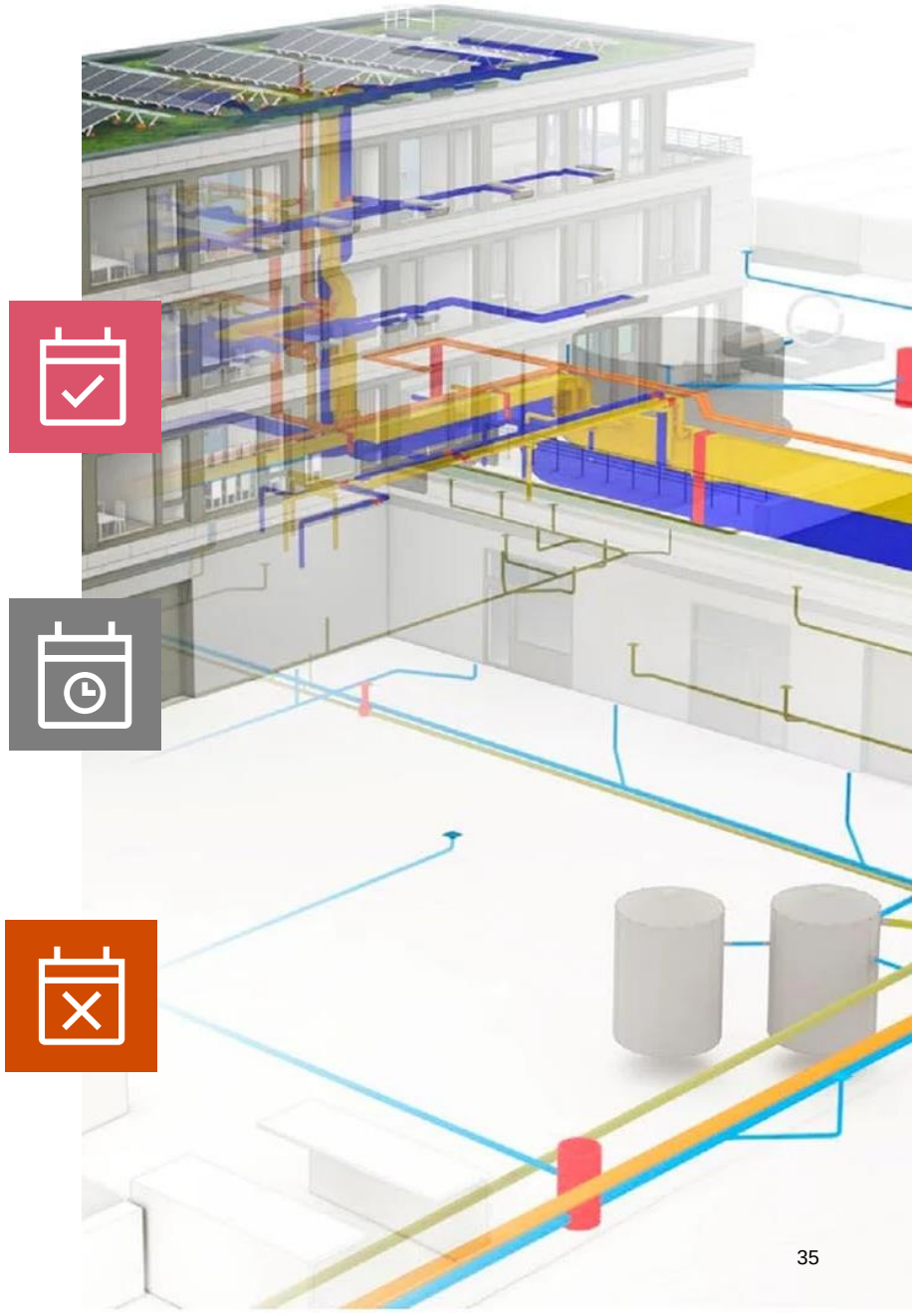
Create and nurture an active digital construction ecosystem

Another success factor that plays an important role in the digitalisation of the construction sector is the **involvement of different groups and organisations**. Private companies, academia, government agencies, and research institutes are all vital **stakeholders to accelerate the pace of digitalisation of the construction sector and contribute to the implementation of BIM**. For example, BIM task groups, research labs, and associations that conduct seminars and workshops are being promoted in South Korea, UK, Malaysia, and Norway. Furthermore, The State of Geneva implemented a BIM Programme that covers several relevant topics only focused on BIM.

07

Invest in BIM education

BIM is quite a complex software to operate, thus **it is necessary to upskill professionals in the construction industry to use it**. For this reason, Norway decided to include BIM courses in all universities with building and/or civil engineering degrees. In addition, the Norwegian University of Science and Technology (NTNU) has a dedicate master's degree in digital construction processes and offers programs in BIM specialisation



Picture source: https://www.detail.de/en/de_en/bim-basierter-bauantrag-wie-funktioniert-das

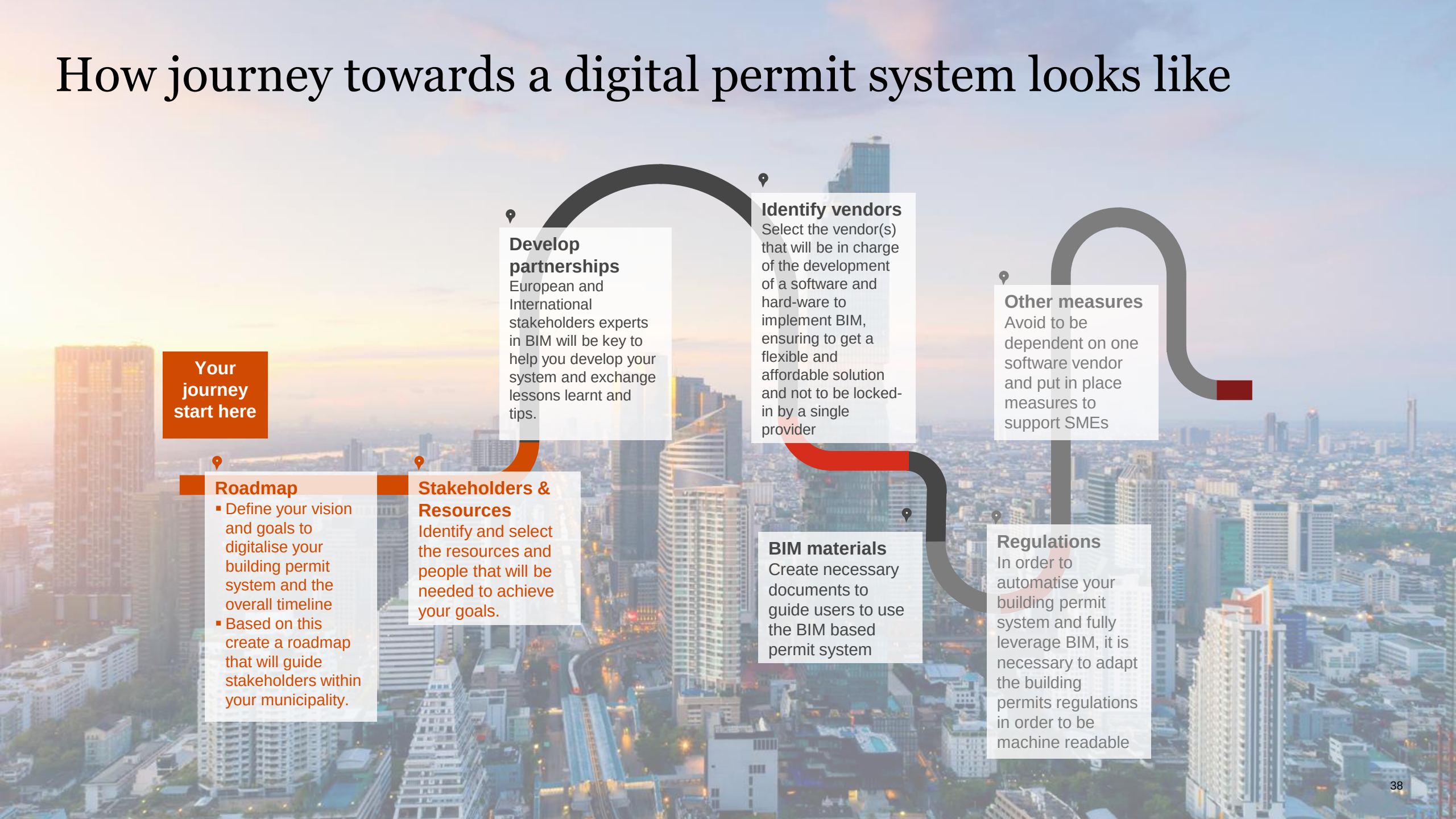
The proposed analysis frontrunners helps municipalities learning from their peers that have already digitalised their building permit system

Go to the next section “Module 4” to get practical guidelines and a step-by-step process to start your journey of building permit digitalisation

Click on the icon if you wish to go back to the menu

Module 4
How to get started? Step-by-step guidelines to start digitalising your building permit system

How journey towards a digital permit system looks like



Roadmap

How to design a roadmap with clear milestones and SMART objectives (1/2)

01 Define your goal

- Start by clearly defining your goal and what you want to achieve. The goal must be specific and understandable by all stakeholders involved. For example, Dubai set as one of their goals to develop the Dubai BIM standards 3.0 by 2023, and launch a monthly electronic newsletter focused on BIM implementation across Dubai by 2021.
- Another example of potential defined goal is to launch an electronic platform to handle building permits by 2024.

02 Identify key objectives

- Break down your goal into specific objectives aligned with your goal and it enable you to reach the desired goal.
- To reach the Dubai BIM standards 3.0, Dubai had to split it in small objective over time, such as to conduct a public consultation to design an action plan

03 Make your objective SMART

- For each objective defined to reach the main goal, you need to make sure it meets a SMART Criteria: **Specific** (clearly define what needs to be achieved); **Measurable** (Identify what will measure success); **Attainable** (objective is realistic and attainable given the available resources); **Relevant** (Ensure the objective is aligned with your goal); and **Time-bound** (Set a timeline for when the objective should be achieved)

04 Prioritise and sequence

- Set up your SMART objectives in a logical order. Some objectives might need to be achieved before others in order to be efficient and ensure that you have all available resources.
- An example of such is the objective C.3.4 “Create an unified process for exchange of information” would not be possible to achieve without C.3.2 “Identify processes and exchange mechanisms for information”.

Source: https://bim.geodubai.ae/Documents/Dubai_BIM_Roadmap.pdf

How to design a roadmap with clear milestones and SMART objectives (2/2)

05 Estimate resources

- Estimate the resources that will be required to achieve each of your objectives, such as budget, personnel, tools, time, among others. Additionally, make sure that all resources are available or possible to be acquired.
- To provide an example, if a municipality wants to implement BIM in the building permit system, it need to account for at least: personnel; software development; hardware infrastructure; cloud service; maintenance; staff trainings; among others.

06 Set deadlines

- Assign deadlines to every specific objective that you defined in order to create a sense of urgency and motivate staff to achieve the objective by established time-line.
- It is possible to observe this action in the Dubai BIM roadmap by defining the quarter of a specific year, when the objective shall be achieve. For example, Dubai set to finalise the development of the BIM E-submission platform by Q4 of 2020.

07 Track progress and Key Performance Indicators

Define KPIs aimed at help you measuring the progress of each of the specific objectives, and providing clear and quantifiable metrics that align the roadmap's objectives with the main goal.

After implementing BIM, it is important to track indicators, such as *cost reduction; applicants' satisfaction; application processing time; and user adoption rate.*

08 Adapt and adjust

- Be prepared to adapt the roadmap as circumstances change. Sometimes, you may need to revise objectives, extend deadlines, or adjust resources.

Source: https://bim.geodubai.ae/Documents/Dubai_BIM_Roadmap.pdf

Stakeholders & Resources

Required resources to start your journey

Technology

Purchase the most suitable BIM software to enable your municipality to introduce BIM in the building permit system. Consult the section on Vendor Selection to learn the criteria to consider when choosing your software provider

01

People & Training

Select the people that are willing to upskill their knowledge and capabilities around BIM and act as enablers. Provide the necessary trainings to the selected people in order to run the project. The next slide provides more guidance on how to get started on people and training

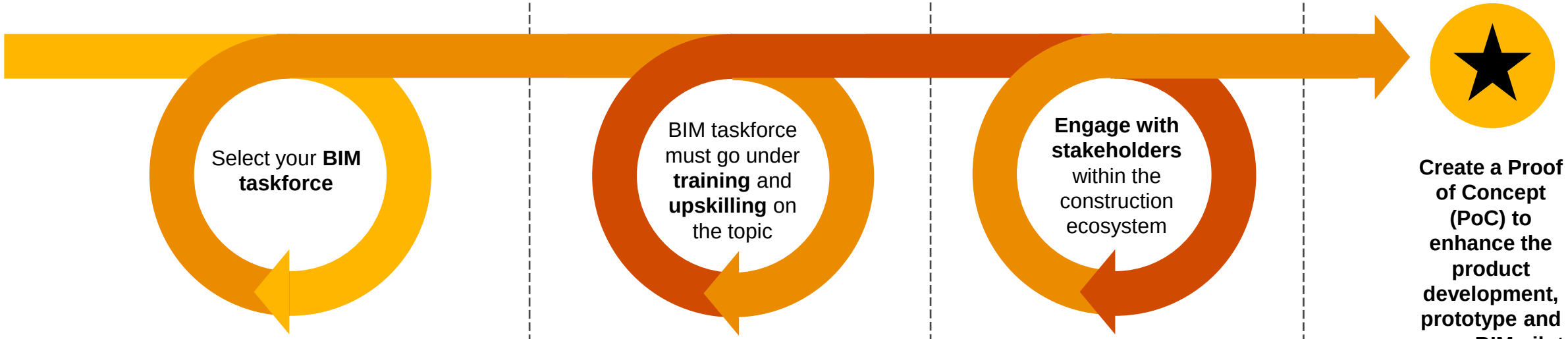
02

Budget & Fundings

An initial investment is crucial to kick off and run the project. Municipalities will need to allocate funds to the implementation of BIM in the building permit system. In order to understand how the size of the investment as well as the expected savings, refer to the section on Benefits and Costs

03

Initial Stakeholder engagement



Start with a small and **selected group of employees in the municipality that will act as digital frontrunners innovators**

At the beginning you are going to have the two systems running in parallel:

1. Digital frontrunners innovators working on a proof of concept of BIM-based permit system to be at some point tested on some pilot cases of applications;
2. Rest of the staff continues to handle the permits with the current system to allow continuation of services

This group of employees shall go through exhaustive **trainings to upskill on BIM.** This will allow them to run the digital building permit platform, as well as **develop BIM materials** to provide to the applicants and to their fellow employees.

Gather stakeholders at various levels in the ecosystem, such as engineers, architects, software developers, users and municipalities workers. Organise a workshop/ideation session, to understand how BIM can actually be implemented in the building permits of the municipality and how it can impact the different stakeholders

Develop partnerships

How to leverage partnerships with universities, companies, software vendors, international organisations (buildingSmart), other cities

To jump-start your building permit digitalisation journey, it is key to developing partnerships with key stakeholders in BIM

Municipalities should seek to partner with:

- Existing EU-level initiatives (CHEK, Accord, EUnet4DBP), to be part of relevant communities and learn from others;
- International organisations that foster the adoption of BIM and OpenBIM, such as buildingSMART
- Local universities and research institutions (such as NTNU in Norway)
- Other municipalities nearby, to create a local ecosystem and establish the same building permit system, for the benefit the local AEC industry

Benefits of creating partnerships with BIM expert organisations

- **Access to research and innovation**
- **Access to specialised BIM knowledge**
- **Industry best practices**
- **Technical support**

International best practices of successful partnerships that led to an improved BIM system

Singapore

Partnership with buildingSMART: Singapore partnered with buildingSMART to establish common standards for sharing information during the construction lifecycle and adopt IFC standards. It provided guidelines how to share interoperable information.

Additionally, buildingSMART created a forum for members to work together on programs to develop the IFC standards and promote practices for information sharing.

Norway

Norwegian construction stakeholders (companies, designers, contractors, customers and universities) share knowledge and experience on BIM: The NTNU Technical University of Trondheim launched an initiative called Prosjekt Norge that aims at gathering universities in Norway to share knowledge about BIM.

Recently, Prosjekt Norge has started intensive work related to BIM by creating a CoP (Community of Practices) working groups, including designers, contractors, architects, customers and suppliers

Peru

Partnership with the UK and South American countries: The Government of Peru is currently part of the United Kingdom Government Prosperity Fund and works hand in hand with specialists from the International BIM Program for the development of the implementation of BIM in Peru. The partnership is intended to share and exchange experiences between the Centre for Digital Built Britain and the Peruvian Government's.

Furthermore, Peru is a member of the Latam BIM network, a regional initiative that seeks to accelerate BIM implementation processes at the governmental level through collaborative work that favours and promotes common guidelines (ISO 19650), commercial exchange, and knowledge in South American countries and the Caribbean

European initiatives and communities working towards the digitalisation of building permits

To achieve a specific objective of your roadmap and reach the final goal of implementing BIM within the building permit system, you can contact the following organisations, networks, and projects, which can be useful to **exchange experiences, knowledge, and capabilities around BIM**.

buildingSMART International is leading the digital transformation by enabling better collaboration and digital workflows through the use of openBIM and IFC standards

Network of stakeholders aiming to define a common strategy for the digitization of the building permit issuing process, focused on interoperability, procedures and data optimization, and standardization

EU-funded project led by a consortium of research institutes and building value chain stakeholders. It aims to provide an innovative toolkit supporting the digitalization of building permit issuing and automated compliance checks.

EU-funded project developed across 5 European countries. It aims to automating the building permit and compliance processes using BIM and other data sources

You can also try to get in touch with the EU frontrunners presented earlier in this presentation

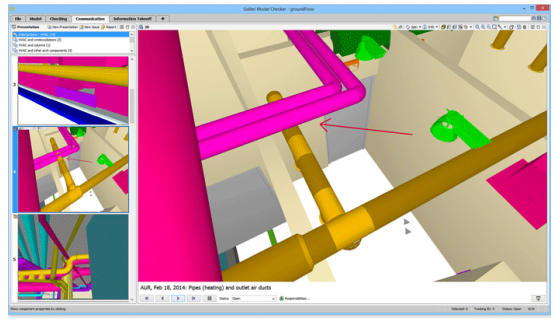
Identify vendors

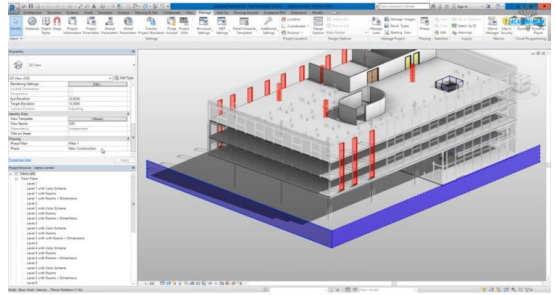
Identify vendors

The next step towards a BIM-based permit system is to develop the software. The majority of municipalities do not have the financial and technological means as well as expertise to develop this system in-house. For example, Tallinn, Helsinki, and Vantaa outsourced the BIM software to a private company, while Vienna hired a consulting company to do it in-house.

When choosing a BIM software vendor, a municipality should take into consideration:

- **Avoid vender lock-in* for applicants** – Choose an **OpenBIM software**, that allows users to upload their BIM models to the building permit platform, created with any BIM software
- **Avoid vender lock-in for municipalities** – **Opensource software solution**** would avoid to be dependent on a specific software vendor (e.g.: price revision, new feature to be added). Currently there are no opensource BIM software solutions on the market
- Choose a solution based on its **ease of use** and possibility of **customisation to your needs**
- Take into account the whole **lifecycle cost**: investment costs, licence costs, hardware and maintenance costs, evolution costs
- Avoid solutions that require users to install/buy any specific interface. A **web-based solution** with a simple interface would be preferable
- Take into account **interoperability, data sovereignty and privacy**





**Vendor lock-in* occurs when a user is forced to continue using a product or service, because switching to another vendor is not practical. Source: https://www.cloudflare.com/learning/cloud/what-is-vendor-lock-in/

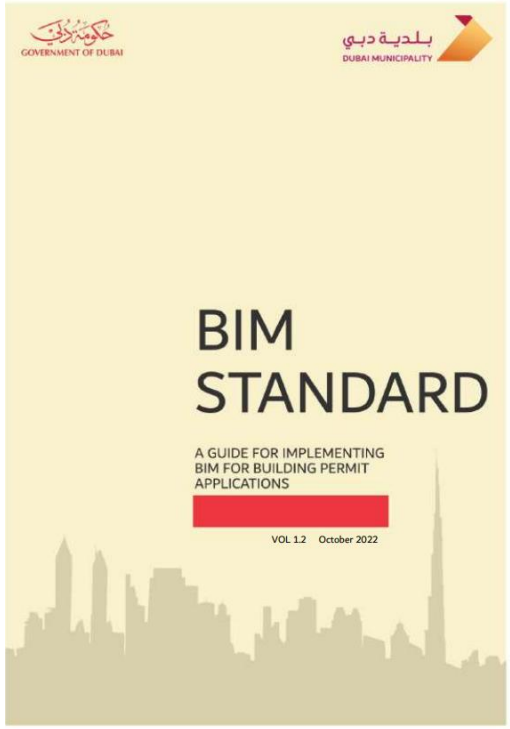
*** Open source software is developed via open collaboration, and its source code is available for anyone to use, examine, alter and redistribute. Source:* https://www.ibm.com/topics/open-source

BIM materials

Municipalities should provide users with support material to ease the adoption of the digital building permit system

BIM standards and guidelines

- The first type of support material that can be provided are BIM standards and guidelines. It is a document that describes the necessary characteristics and requirements that users must respect in developing their BIM models and uploading them in the platform.
- For example, in Dubai, the document describes the necessary tools, templates, requirements, and modelling practices required to develop a high-quality BIM model that can be submitted in the platform.



Format	Open Format?	Description	BIM Use	Delivery
Open BIM format (.IFC)	Yes	Industry Foundation Class by buildingSMART	Information/Model exchange	Required for all building permit submissions where BIM is mandated
Native file format	No	Proprietary BIM Software Platform	Design Authoring	Required for all building permit submissions where BIM is mandated (supplementary file)
AutoCAD – .DWG/.DWF	No	CAD software platform – exported directly from BIM	Drawings	Required for all building permit submissions where BIM is mandated
Portable Document Format (.PDF)	Yes	PDF exported directly from BIM	Drawings	Required for all building permit submissions where BIM is mandated

Source: https://bim.geodubai.ae/code-checker

The BIM manual provides a step-by-step user journey on how to use the BIM-based software

BIM Manual

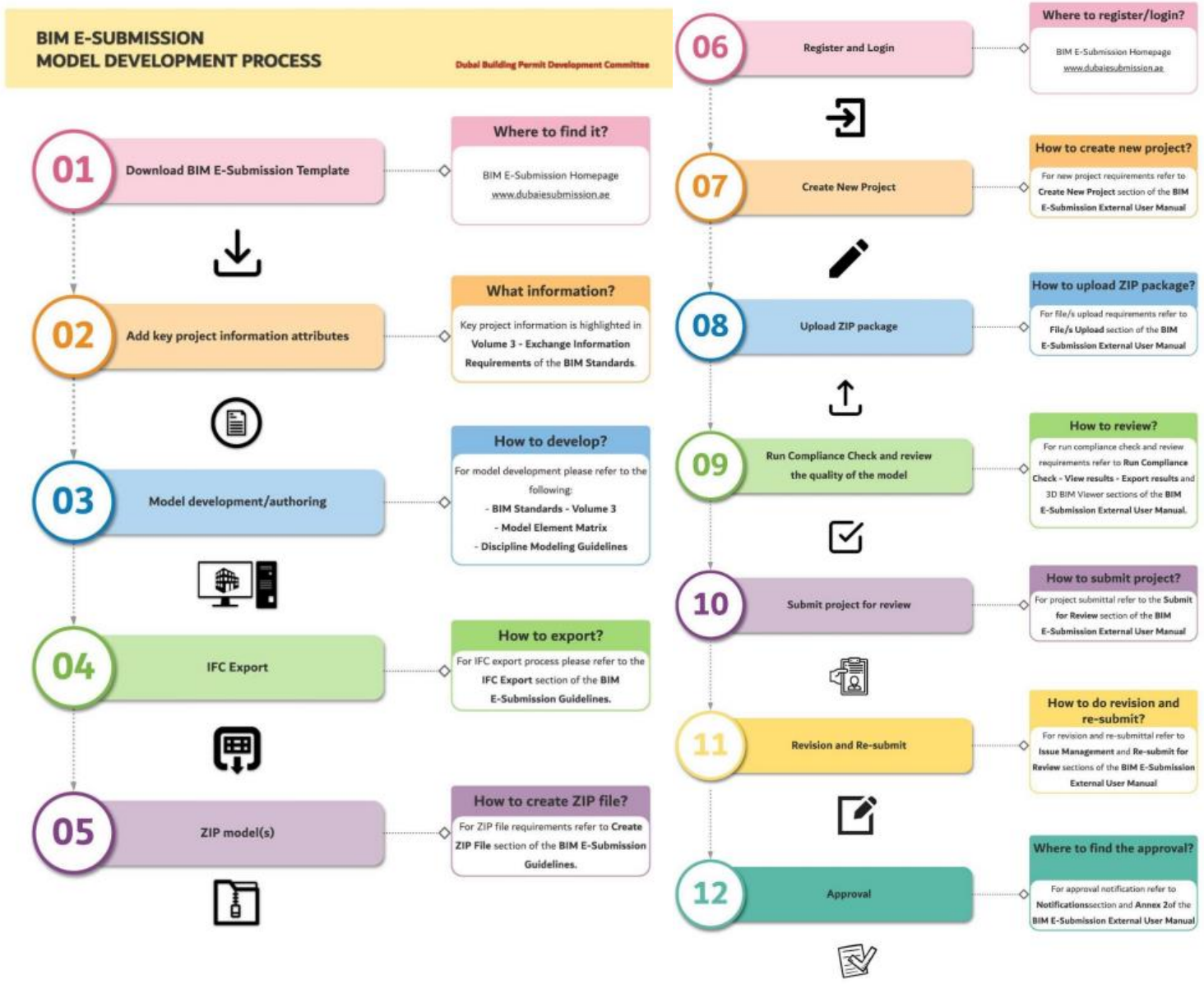
- The document aims to serve as a user manual, to explain users the steps they must follow to upload BIM files as part of their building permit application
- The Manual guides users throughout the whole process in a step-by-step way
- Further, it includes guidelines on how to ask information, export models to the platform, create and submit projects, etc.
- In the case of Dubai, it provides a step by step explanation on the BIM model development process, how to use the BIM templates and export BIM models into the Dubai BIM e-submission platform.

You can find the Dubai's BIM Manual here.

Source: https://bim.geodubai.ae/Documents/BIM%20E-Submission_Public%20User%20Manual.pdf

Dubai BIM manual (1/2)

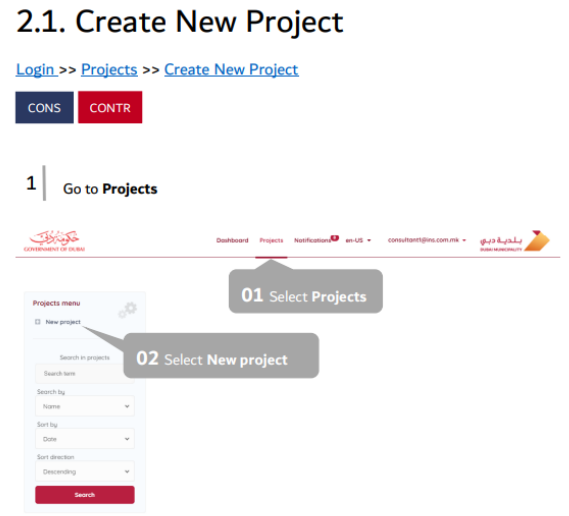
- The screenshots on the right show how Dubai BIM Manual guides users throughout all the steps of their building permit application, in a visually attractive and simple manner
- The whole process can be visualised as shown on the right, with an explanatory note on the right of each step. Then users can access each step to find detailed instructions

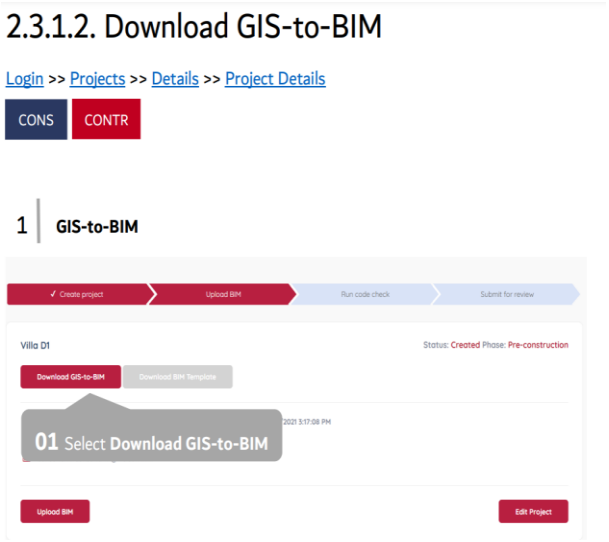


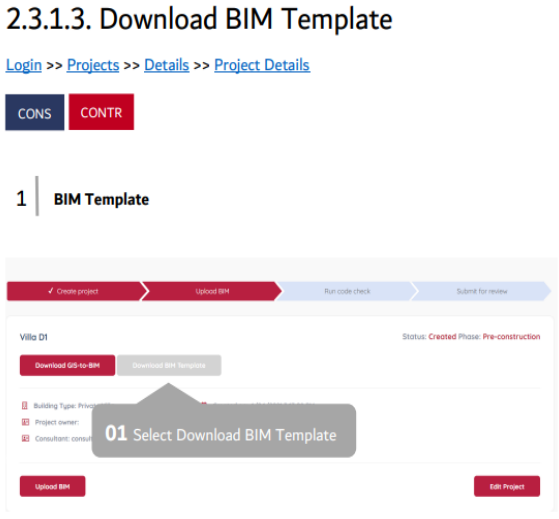
Source: https://bim.geodubai.ae/Documents/BIM%20E-Submission_Public%20User%20Manual.pdf

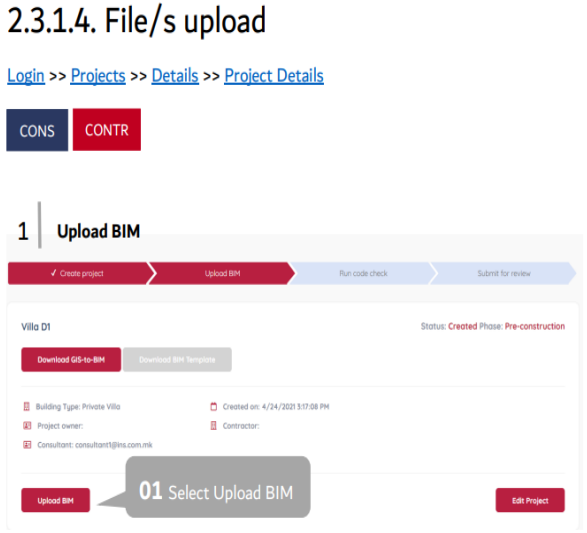
Dubai BIM manual (2/2)

- Dubai municipality included within its BIM Manual every step about how to build and submit the project with clear pictures, in order to provide clarity and help applicants to navigate through out the BIM model.
- To increase the applicant's adoption to the GIS tool, the BIM Manual provides an explanation on how to integrate georeferencing (GIS) into the BIM model. The aim is to visualise the surroundings of the building, and allow the applicant and the municipality to be aware of potential external risks affecting the building









Source: https://bim.geodubai.ae/Documents/BIM%20E-Submission_Public%20User%20Manual.pdf

Video trainings are engaging and encourage independent learning for users and municipality's employees

BIM Trainings

Municipality

In order to ease the BIM adoption within the municipality, the employees working in the building permits department must go under training on several topics such as:

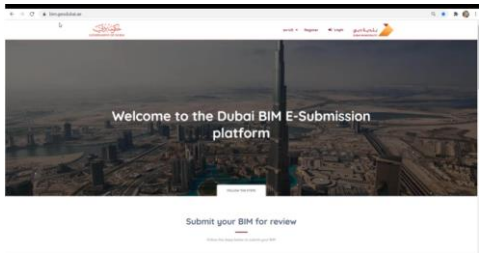
- BIM Software/Platform usage
- BIM standards and workflows
- Input data in the platform
- BIM regulatory requirements
- Check permit against defined regulations
- Why the BIM model requirements are necessary

Users

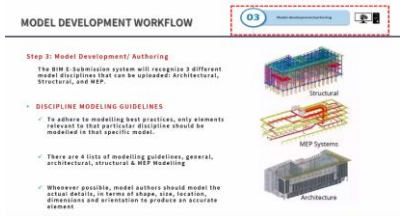
To facilitate the adoption and usage of a designated BIM e-platform by applicants, **it is crucial to provide free training videos to users** about the process workflows, platform usage, requirements and guidelines to submit the project.

The government of Dubai provided free trainings videos related to 4 distinctive areas:

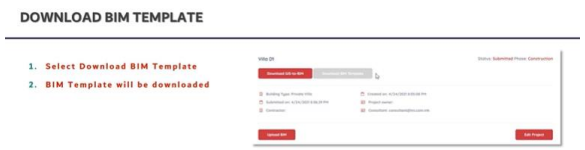
Platform Demo



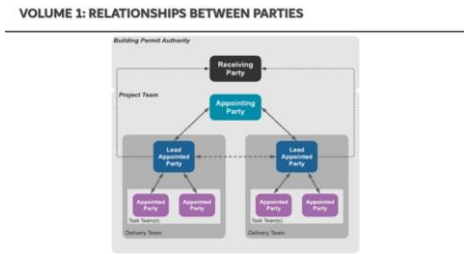
Model development guidelines



Platform collaboration functionalities



BIM standards and documentation



Regulations

High-level guidelines to make regulations machine readable

Each country, region, and sometimes even municipality, has different procedures and types of building codes, and land use plans.

A building code regulates the interior of a building, while a land use plan regulates the relationship between the building and its surroundings.

There are **two types** of requirements in building regulations:

1. **Quantitative specifications**: Expressed with discrete and measurable metrics (i.e. more than 900 mm, 4 m, 12 $mm2$, 32 kN, etc…)

2. **Qualitative based specifications:** Expressed as purpose (function/goal) without discrete metrics, meaning that rules are qualitative and require interpretation.

Municipalities face limits to digitize their building permit process and making regulations machine readable and thus automatically checked.

The **two main obstacles** are:

1. The **complexity of the legal framework** requires several procedures. Building regulations might be divided in several parts of the legislation (fire safety, energy efficiency, building standards, etc.), which requires an overall knowledge about all relevant regulations.
2. Lack of flexibility and rationality in regulations: regulations are either too specific (inflexible) and/or leave too much room for interpretation (irrational, not prescriptive)

Step by step high-level guidelines to turn regulations into machine readable

Assess your current regulations: Begin by evaluating your existing building regulations. Identify the key rules, requirements, and information that are typically required for permit applications. This includes zoning codes, building codes, safety regulations, and any other relevant guidelines

The BIM Team selected previously to start the BIM-based permit system will be in charge of guiding the implementation process with the selected BIM software.

Digitise Regulations: Make a comprehensive assessment of the regulations and requirements and make them flexible, rational and quantitative.

Convert your building permit regulations into machine-readable formats, such as IFC (Industry Foundation Classes). This format is commonly used in BIM and can be read by BIM software

Develop BIM template: Create a standardized BIM template that includes the necessary parameters and properties for your permit regulations. This should define the attributes required for building projects, such as building height, parameters, distances, and more

Input the digitized regulations into your selected BIM software. Assign the properties and parameters from your template to correspond to specific elements of your regulations. This will allow you to tag and label objects with the relevant information.

Develop user guidelines and training materials: Create user guides and training materials for internal staff and external applicants who will use the system. This should include instructions on how to input data and extract information from the BIM system.The materials shared must be tailored for the role of the user, meaning that the guideline materials for users shall be different from the ones shared with applicants

Pilot Implementation: Start piloting to validate checks and ensure the data in the BIM system complies with the current regulations and remains accurate. Make refinements if necessary.

Full implementation and continuous monitoring: Once the pilot is successful, roll out the BIM-based machine-readable regulations for all building permit applications in your municipality.

Continuously monitor the system's performance, gather feedback, and make regular updates to keep the regulations and the BIM system aligned with evolving standards and regulation

Based on the EU's frontrunners experience, we recommend to start by only turning the **quantitative building regulations** into machine readable. Rules and metrics that are measurable and quantifiable, such as distance between objects, parameters, and size of objects can be transformed into machine readable, and consequently BIM can automatically check, since there is no qualitative interpretation.

Work closely and engage on with those responsible for building regulations in your municipality/country, to assess the rules and regulations, and potentially to reformulate them, if necessary.

Final Note

Municipalities may not achieve 100% machine readable regulations due its complexity and low flexibility.

The experience of frontrunners shows that leaving some room for human interpretation for not quantitative regulations, is actually a positive element. This allows to have a contextual understanding, interpreting ambiguities, and leverage people's experience in the construction sector.

Other measures

Level-playing field: (i) how to include SMEs and (ii) avoid vendor lock-in

In the EU, SMEs make up the majority of firms operating in the construction sector: **95% of construction firms have five or fewer employees** and only 1% of companies have more than 50 employees.

As such, implementing systemic changes, such as pushing for the use of **BIM in building permits, has to take into account the needs of SMEs.**

BIM adoption in SMEs can be complex, as they generally face **lack of resources**, **BIM awareness** and **collaboration with other firms**.

To mitigate this issue and enable SMEs to benefit from – and be active part of – the digitalisation, governments from Singapore and South Korea implemented strategies not only to financially support companies in their digitalisation investments, but also to increase the adoption of BIM

Include SMEs

BIM Fund: Budget provided to early adopters to cover initial investment costs for BIM training, consultancy services related to the system and purchase of hardware and software

BIM Service Fee: Reimbursement of the expenses to implement BIM software. It includes costs on the BIM hardware and software as well as the staff training

Keep the possibility of **submitting applications in paper** so that firms that cannot afford to transition to BIM are not excluded.

Avoid vendor lock-in

The use of an OpenBIM model enables stakeholders to only use one BIM software, not being forced to train staff and purchase different software depending on the project's requirements

The proposed practical guidelines and a step-by-step process helped your municipality to start its journey of building permit digitalisation

The following section is a collection of useful links and resources

Click on the icon if you wish to go back to the menu

Library and useful resources

Useful communities/initiatives to monitor and, possibly, be part of

- buildingSMART (link)
- European Network for Digital Building Permits – EUnet4DBP (link)
- ACCORD project (link)
- CHEK project (link)

Useful sources from international frontrunners

- Dubai BIM roadmap (link)
- Dubai BIM standards and guidelines (link)
- Dubai BIM manual (link)
- Dubai BIM training videos (link)

Useful resources and frameworks to select vendors of IT systems

- Gartner: How to Evaluate Technology Vendors Properly (link)
- Gartner's Magic Quadrant (link)

European Commission Studies on BIM & digitalisation of the Construction Sector

- The EU Handbook - for the introduction of BIM in public procurement (link)
- The methodology and tool to conduct Cost Benefit Analysis for the use of BIM in public procurement (link)
- The study towards an EU framework for digital building logbooks (link)
- Analytical Report of the Construction Sector Observatory, which focuses on Digitalisation in Construction (link)

Click on the icon below if you wish to go back to the menu and navigate across the various modules of the toolkit