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INNOPOLIS Engineering

Vision of e-construction platform

Vision paper of 2018

CONTENTS

DEFINITIONS USED

3D visualization	Creation of three-dimensional or spatial (static or dynamic) graphic images of the modelled objects.
Data exchange format	Format for saving, receiving, sending and archiving data that is comprehensible to the software.
BIM	Building information model, building information modelling, building information management.
Level of detail/level of development	Terms “level of development”, “level of detail” and “data drop” do not have a uniformly defined Estonian equivalent in the context of BIM. Level of detail/level of development refers essentially to the extent of modelling, level of detail of geometry and data composition of the project at a certain time moment.
Digital twin of the built environment	Complete data model of Estonian built environment.
Building’s life-cycle	In the context of this document, building’s life-cycle is defined as a conception that characterizes the stages of buildings, from initial idea until demolition. Building’s life-cycle stages include planning (the concept), designing, building, operation (maintenance) and demolition.
Parties of building’s life-cycle	In the context of this document, parties of building’s life-cycle include all people who are exposed to various stages of building’s life-cycle. Among others, the term refers to developers, architects, designers, engineers, builders, administrators, and officials of local government.
Building information management	The goal of building information management and administration is to organize and to control business/construction processes throughout the stages of building’s life-cycle by utilizing building information models.
Building information modelling	The term refers to tools, processes and technology that enable to create a digital database/data set/model of the building and to utilize the information that is necessary for constructing the building.
Building information model	The term refers to three-dimensional digital representation of the physical and functional characteristics of a building or its parts. The model may also contain information on the manufactured of the building’s elements, cost, etc.
Building sector	In the context of this document, the business sector includes all companies that are directly exposed to building’s life-cycle. Among others, the term refers to developers, architects, designers, builders, administrators, and managers.
Classification	A systematic set of sections and subsections that enables to categorize (or to define, group, classify) property types, elements of buildings, systems and products. Examples of building information classification standards or guidance materials of various countries: Masterformat (United States of America, Canada), UniFormat (United States of America, Canada), Uniclass (United Kingdom), Talo 2000 (Finland), EVS 885:2005, Omniclass (United States of America), CoClass (Sweden), etc.

Model-based approach	Data handling where for example one product is presented as a model and parts that form it so that the software automatically interprets the data contained in the model and uses them for subsequent analysis, representation, data exchange, etc. (Note: compare with document-based information, in case of which the software is incapable of interpreting the content of the document. Content presented in the document provides a textual or graphical description (presentation) of the object that is interpretable only by humans.)
Inspection of contradictions	The goal of the inspection is to detect conflicts in the model and to increase thereby the quality of designing. Contradictions may involve geometric intersections or non-compliance with substantial requirements.

1. INTRODUCTION

The **objective** of this vision of e-construction platform is to create a framework for the e-construction platform under establishment. Over the next stages, the vision will be the basis for evolving detailed description of business requirements and business processes and respective IT architecture. The planned e-construction platform is an organic part of the unified digital ecosystem of the e-country, and encompasses the whole building's life-cycle from designing until demolition.

The biggest hindrance of introducing digital solutions in the construction sector lies in the lack of common grounds of information exchange, agreements and IT solutions. Therefore, it is necessary that the public sector initiates implementation of alterations in order to govern the change of the relevant paradigm that is necessary for digitalization of the construction sector, which enables to solve the structural problems of the construction sector and thereby to increase productivity. The platform described in this vision paper is just one initiative of a larger variety of activities that are necessary to achieve success in e-construction and the construction sector in general.

Vision of e-construction is defined in the context of the project as a prospect for the future that should be achieved within a certain timeframe. Existence of the vision is the prerequisite for making conscious decisions – the vision enables to judge whether an activity is purposeful or not. The vision has to be sufficiently ambitious in order to drive different parties to take actions – its attainment should not be autogenous. At the same time, the vision has to be realistic and achievable for motivating the parties to make respective efforts.

The vision is based on mapping of the current status of Estonian construction industry and relevant influential field-specific trends, and analysis of international best practices. Overview of the current status of the construction industry and the trends is provided in the supplemental background document of developing the vision of e-construction platform.

The vision paper is in addition to the background document also complemented by an activity plan. The vision and the background document form an unified set, but are also readable separately.

The vision has been prepared in collaboration of the Ministry of Economic Affairs and Communications, enterprises of the construction sector and representatives of the public sector. Within the scope of compiling the vision, altogether 16 interviews and 4 workshops were conducted with field-specific experts in order to create the framework and to clarify the main principles.

This vision paper is not targeted to describing trans-sectoral strategical trends – it focuses on a state established platform that would be one of the instruments that influence the development of the sector. The vision paper explains the goals of e-construction platform, underlying principles of the platform under establishment, services offered and the user view. It also provides an overview of the focus fields which must be taken into account on implementing the vision, and a brief analysis of amendments of regulations that are necessary for imposing the vision.

Vision of e-construction platform and the accompanying background document has been compiled by Civitta Eesti AS on the order and active participation of the Ministry of Economic Affairs and Communications over the time period from June 2018 till November 2018.

Contributors of vision development:

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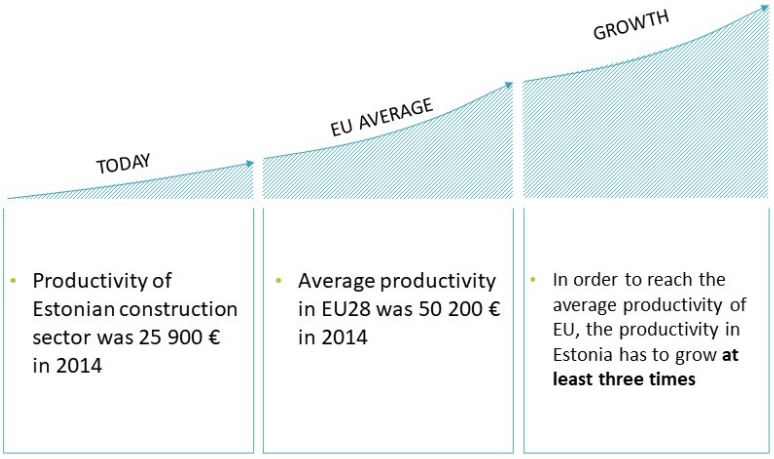
2. E-CONSTRUCTION VISION AND ITS GOALS

2.1. LONG-TERM VISION OF THE CONSTRUCTION SECTOR

Long-term vision of the construction sector emanates from the strategic objective of raising the productivity of Estonian construction sector the latest by 2030 to the average level of the European Union, which means at minimum a threefold growth (figure 1)[1].

FIGURE 1. STRATEGIC OBJECTIVE OF ESTONIAN CONSTRUCTION SECTOR



Attaining the defined objective presumes parallel development of several fields that influence the construction sector, because the growth of productivity is achievable only in synergy of these domains. The fields that affect the construction sector are presented on figure 2. At the same time, e-construction is the enabler and amplifier of various other domains. For example, utilization of information and communications technology (ICT) solutions is the prerequisite of automation of processes and facilitates introduction of novel management techniques (Lean, integrated project delivery (IPD)).

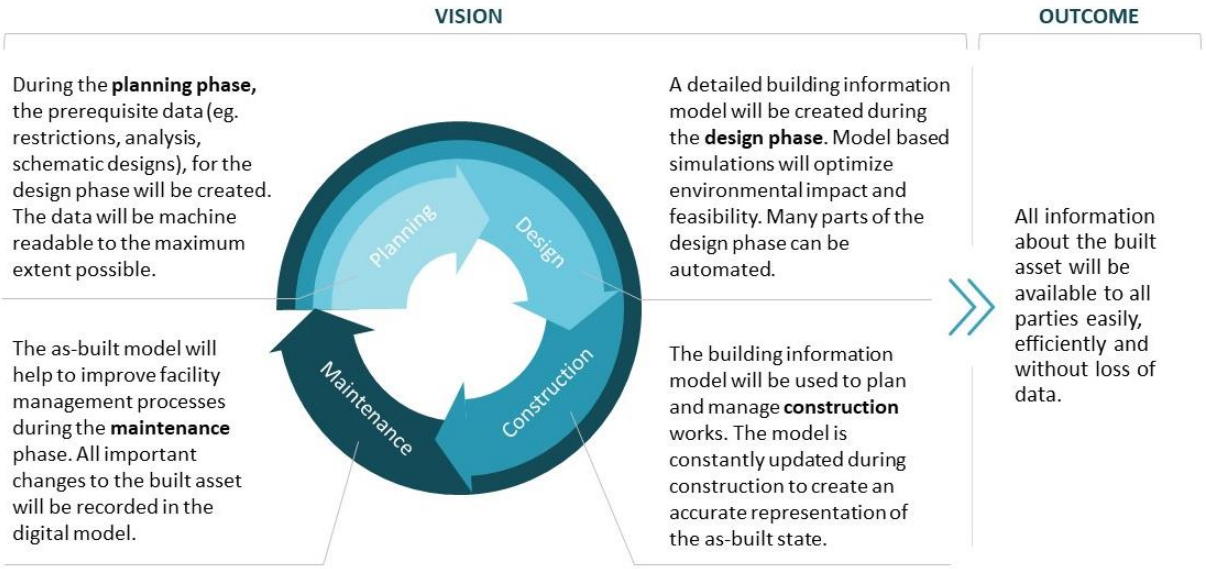
FIGURE 2. LONG-TERM VISION OF THE CONSTRUCTION SECTOR

[1] Source: European Construction Sector Observatory. Country Profile Estonia. March 2018; European Construction Sector Observatory. Country Profile Romania. June 2018

2.2. LONG-TERM VISION OF E-CONSTRUCTION

One of the most important methods of ensuring increased productivity of the construction sector involves raising the efficacy of operational processes and information flows of the sector, which results in higher added value per employee of the sector. Hence, long-term vision of e-construction has to encompass digital and smooth movement of information, and close collaboration of all participants of the sector for the attainment of the mutual goal. Long-term vision of e-construction is provided on the figure below.

FIGURE 3. LONG-TERM VISION OF E-CONSTRUCTION



Long-term vision of e-constructions encompasses the following **principles**:

- Implementation of the vision results in creation of the digital twin of Estonian built environment, which ensures simple and convenient operative access to all data relating to buildings.
- Creation of the digital twin of Estonian built environment takes spatial planning to the next level, which enables to improve the quality of life of the inhabitants of the existing settlement system in the maximum possible extent. It is possible to fit new buildings into the surrounding environment already in the development phase and to analyze their potential influence. In addition, attention is paid to capitalizing the development potential of different areas.
- Development, designing, building and utilization of buildings involves all parties of the building's life-cycle who work in the name of attaining a joint goal. Respective joint goal is establishing the object with optimal costs that incur across the life-cycle, which means that stages of the life-cycle are separately optimized only when it does not affect the expenses occurring throughout the building's lifespan.
- Representatives of various life-cycle stages are engaged in the building process as soon as possible (for example, on making planning decisions, designing, etc), which reduces the amount of mistakes made during building process and resource costs that derive from amending them, which in turn raises the quality of construction. Engaging the aforementioned parties in an early stage creates preconditions for leveling the distribution of liability between the parties of the construction process.
- Information and data collection and exchange takes place automatically during the construction process, without excessive manual effort. Utilization of building information models enables to apply automatic control mechanisms, which reduces the amount of human errors. This means that creation and exchange of data is partially automated throughout the building's life-cycle, from designing until demolition.

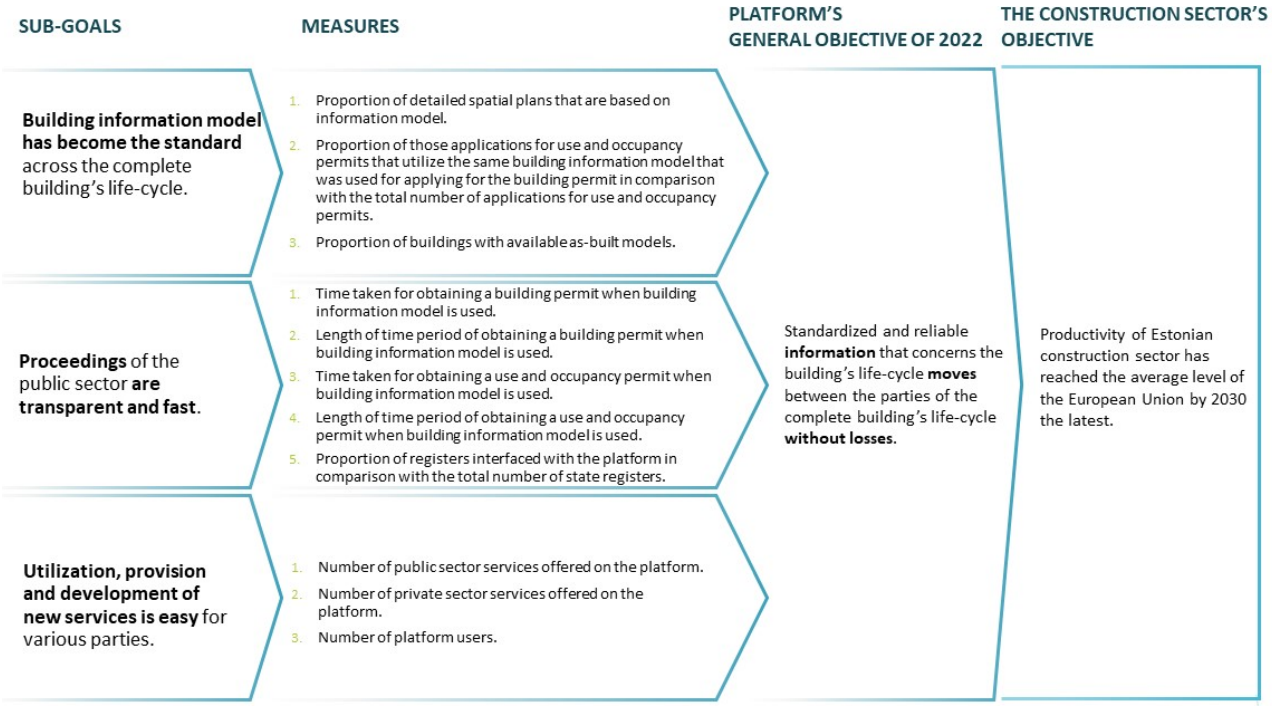
- Information and data move between the parties of building's life-cycle smoothly, without failures and information loss. The data is transferred to the systems of all parties without the need of converting their format or with automated alteration of formats.
- Relevant parties have uninterrupted access to the data developed during the building's life-cycle, and data updating is constant and automated. Information system is constructed so that the relevant parties have the opportunity of updating various object-related data simultaneously. Available data are pertinent and reliable.
- Communication with the state and local government is fast and efficient. Parties of the public sector have the option of assessing the building's suitability and conformity on the basis of information models, and thereat part of the verification takes place automatically without the official's intervention. This reduces the work load of officials, and enables to focus on transparent and reasoned decision-making. This results in improved productivity in the public sector as well.
- Higher availability of information makes the construction sector and the construction process more transparent. Data-driven decision process enhances the quality of the decisions made.

One of the biggest obstacles of implementing long-term vision of e-construction is the low level of utilizing digital solutions in the construction sector. The state/public sector is capable of stimulating the use of digital solutions by simplifying information exchange between the parties of building's life-cycle and the public sector. Therefore, the subsequent focus of this document will be placed on description of the principles of **e-construction platform**.

2.3. OBJECTIVES AND MEASURES OF E-CONSTRUCTION VISION

The **strategic objective** of developing e-construction vision is contribution to the productivity growth of Estonian construction sector. The established goal for Estonian construction sector is to reach the average level of the European Union by 2030.[2]

FIGURE 4. OBJECTIVES OF THE CONSTRUCTION SECTOR AND E-CONSTRUCTION



[2] This objective has been formulated for developing the framework of the vision of e-construction platform and for simplifying establishment of the measures, and it does not convey the ultimate goal that has been agreed trans-sectorally.

This vision of e-construction platform, including the objective and measures of the platform, have been compiled in consideration of the strategic objective. Development of the construction sector and raising the productivity are possible only with the synergy of various factors. The state is in this context able to give its contribution by improving availability of public data and simplifying communication with the public sector. E-construction platform under establishment will serve this purpose.

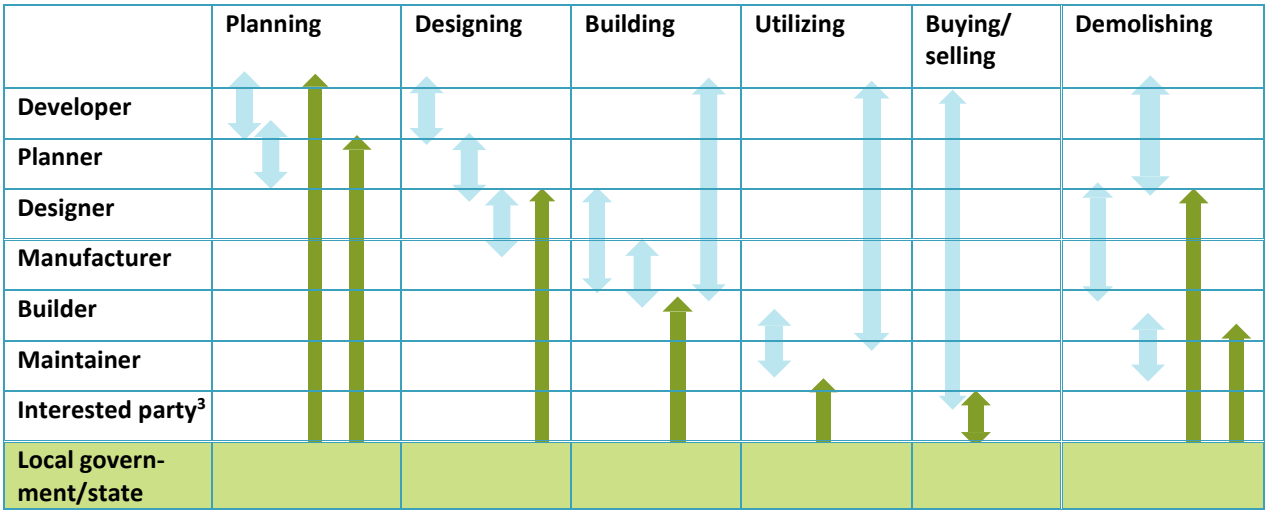
3. DESCRIPTION OF E-CONSTRUCTION PLATFORM

3.1. FRAMEWORK OF DEVELOPING E-CONSTRUCTION PLATFORM

Vision of e-construction platform has been developed on the basis of studies reflecting the performance of the construction sector, and results of the interviews conducted with experts. In addition, consideration has been given to the general strategic objective defined for the construction sector. The presumption is that enhancing the communication between the parties of building's life-cycle and the public sector also creates the prerequisites for altering the paradigm of creating, exchanging and storing data in the private sector. Therefore, the platform is focused on ensuring data exchange between the parties of building's life-cycle, the local government and the state.

Aggregating data entry and proceeding to a joint platform creates additional transparency in communication with the state for all participants. The analytics module that will be integrated with the platform enables to analyze arisen hindrances, and forms the ground for optimizing application and proceeding processes.

TABLE 1. DATA EXCHANGE BETWEEN THE PARTICIPANTS OF THE CONSTRUCTION SECTOR IN THE CONTEXT OF THE VISION



Development of this vision has centered on information movement, which is designated with green arrows on the figure. Blue arrows represent information movement improvement of which is not the direct goal of the platform under establishment.

Development of e-construction platform grounded on the following principles:

- Data are **entered** into the system **once**. It is possible to reuse already entered data on subsequent occasions. One-time data entry also means that it is not necessary to enter additional information in order to share the data with other parties via the system. This reduces the costs of filing information as the expenses of re-submission equal with zero.
- The platform **functions as the main entry point** for all public sector services that are related to the building's life-cycle. The platform integrates exchange of building-related information between the user and the public sector, which eliminates the need of using several information systems in parallel.
- The platform always displays **most recent available data**. The data are not stored on the platform – they are transferred through the platform to relevant registries and systems.
- The data presented on the platform are of **high-quality** and their **correctness** complies with the required limits. The data submitted via the platform fulfil all requirements, they are reliable and

[3]In the given context, interested party refers to an interested person who is not a specialist of the field. Interested party could for example be a private party who orders or a buyer.

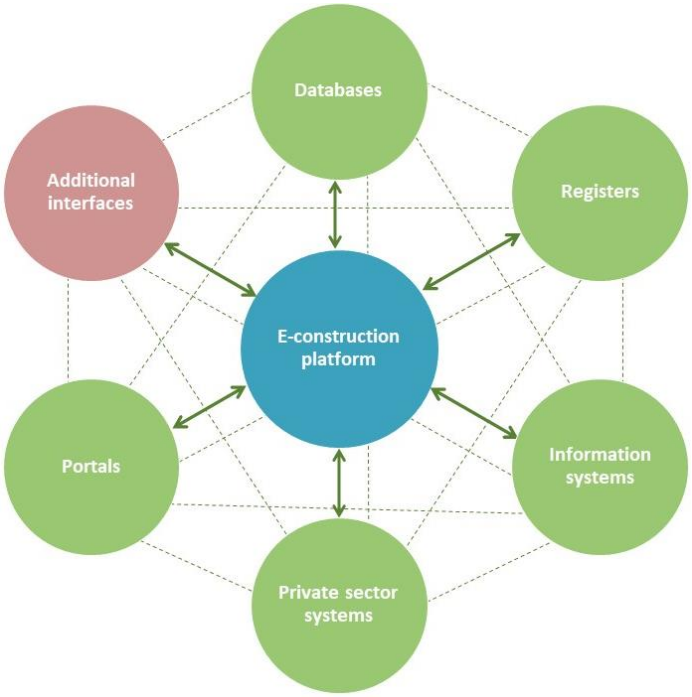
the parties of building's life-cycle are able to use them in their work.

- All data that are obtained from the platform and that are entered to the platform are **machine-readable** (except for data which alteration to machine-readable format is not reasonable).
- Development of the platform supports **implementation of innovative solutions** by the parties of building's life-cycle. The private sector has the opportunity of interfacing their solutions with the platform and offering their services via the platform to all users.

3.2. PRINCIPLES OF INFORMATION MOVEMENT

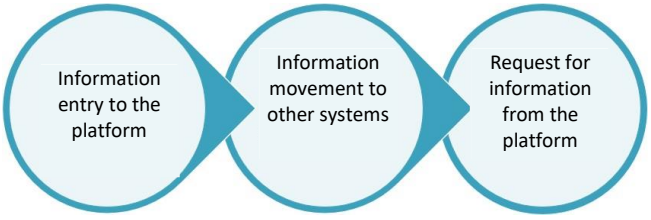
The basis of e-construction platform is constant and bidirectional information movement between various existing information systems and the platform. This means that information is not stored on the platform, and entered information is transferred from the platform to the relevant information system.

FIGURE 5. INTERDEPENDENCY OF E-CONSTRUCTION PLATFORM AND OTHER INFORMATION SYSTEMS



Data exchange is also reciprocal – when the user utilizes the platform for submitting a request for information, the platform collects most recent information from various systems and displays it to the user. The view does not change for the user and information collection that takes place in the background is not visible to the user.

FIGURE 6. INFORMATION MOVEMENT BETWEEN E-CONSTRUCTION PLATFORM AND OTHER INFORMATION SYSTEMS



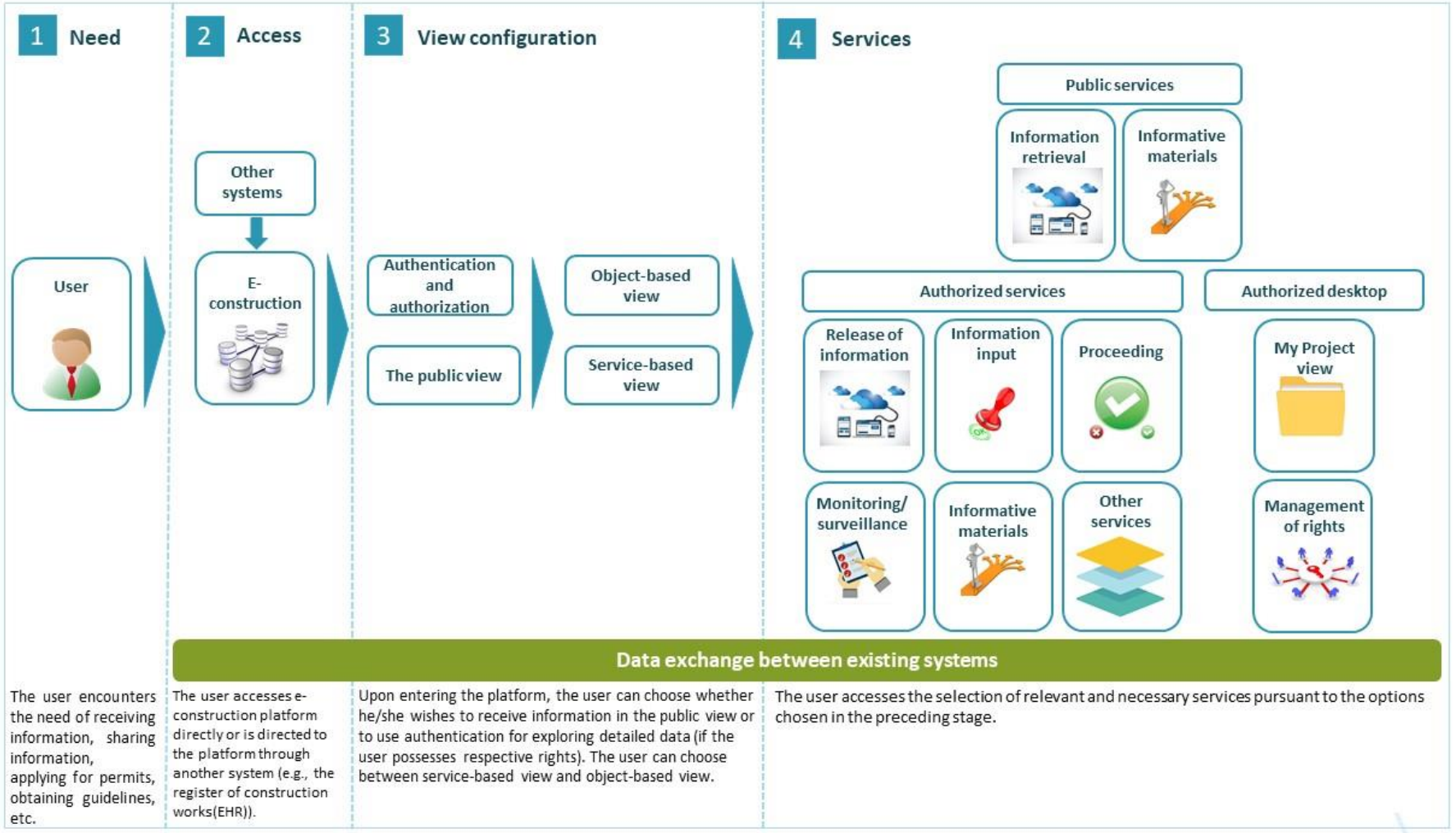
The platform will be equipped with the option for automating information exchange with external information systems, which facilitates sharing and obtaining information for various parties. This enables the companies to transfer and receive data automatically on obtaining and entering information.

3.3. USER VIEW OF E-CONSTRUCTION PLATFORM

E-construction platform is an integration environment that is used for interfacing various already existing and operable systems. Thereby, the platform represents a flexible environment that supports innovation. The platform will be equipped with the option for interfacing new services, and the platform will be developed and constantly improved on the basis of the changes and trends occurring in the sector. Such structure enables to combine information deriving from various sources, which thereby provides additional value. Current vision does not explore the need of adjusting the integrable systems.

The following figure describes the central view of the e-construction platform from the aspect of procedural logic.

FIGURE 7. USER VIEW OF E-CONSTRUCTION PLATFORM



Utilization process of e-construction platform involves four main steps.

TABLE 2. DESCRIPTION OF THE STAGES OF E-CONSTRUCTION PLATFORM

	STAGE	DESCRIPTION
1.	Need	The process is initiated by the user's need to obtain important information and to conduct activities that concern the built environment. Users could be parties of the building's life-cycle or people who have interest in a particular registered immovable/building. In addition, users are parties of the building's life-cycle who within the scope of their activities encounter the need of sharing information particularly with the state/local government, but also with other parties of the building's life-cycle when the private sector solutions are interfaced with the platform. The circle of users also includes officials of the local government or a state agency whose duty is to proceed or verify information that is required from the viewpoint of the building's life-cycle.
2.	Access	The user who needs to obtain or share information has the option of accessing e-construction platform directly. The user can also visit the site of some other existing system (the register of construction works, the land register, eesti.ee, etc), which directs the user to e-construction platform. When the user accesses the platform, the platform displays general information about the platform and the opportunity of entering the environment by authenticating oneself.
3.	View configuration	E-construction platform enables to choose whether one wishes to continue with the public view or to authenticate and authorize oneself, which ensures access to additional data and services. E-construction platform can be used in accordance with the user's preferences with the view that is based on service groups or objects. • The user finds the necessary service from service groups and the service-related object is defined under the scope of the service. or • The user defines the object under interest on the basis of the address, registered immovable number or another unique characteristic[4] or by using map search that enables to choose the necessary service from the object-specific services. • The user is able to add additional filters and map layers in accordance with particular needs. It is also possible to create role-based pre-defined filter packages on the basis of the common information needs of main user groups. At the same time, role-based packages do not limit the information that is available to the user, and the user can use supplementary filters in addition to the pre-defined packages. Information and services that are available to the user depend on the user's rights in relation to the chosen object. When the object is not related to the user, only public information about the object is displayed. Additional object-based rights are specified automatically upon authorization. For example, all object-related information and relevant services are displayed to the owner of the object. • The owner can confer powers of exploring certain data and accessing services to third parties. As an example, it is possible to confer the rights of applying for the building right to the designing company.

[4]Within the scope of this vision, the term "registered immovable" refers to all determinable objects, and covers in addition to registered immovables also roads and civil engineering works.

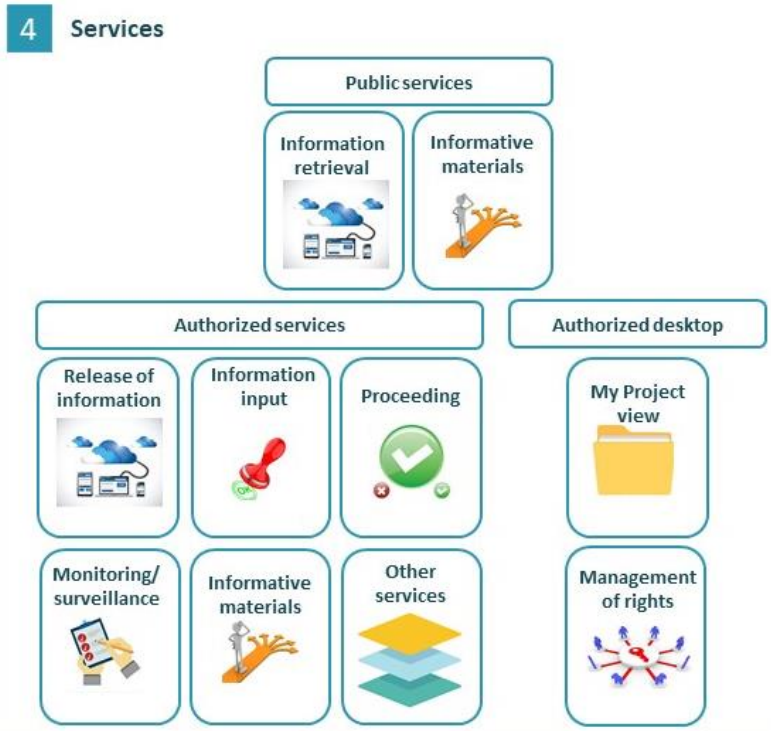
	STAGE	DESCRIPTION
4.	Services	User's opportunities are displayed on the platform as services composition of which depends on whether the user is authorized and on the options that the user has chosen in stage 3. Several service groups require rights for displaying and/or modifying object-related detailed information, and are therefore accessible only to authorized users. The list of the services presented on this chart is not final. Precondition of establishing the platform is the opportunity of supplementing the list of services offered on the platform and modifying them on the basis of the needs of various parties. **The public view** The public view displays information retrieval services and informative materials to the user. The following list provides a general overview of the services. A more detailed description of the content of the services is given in subsection 3.4. Services of information retrieval include the following: • Display of 3D view of object-related plans, utility networks and restrictions. The view contains also data on previously conducted studies and information about adjacent registered immovables (existing buildings, plans, known developments). Registered immovable view is generated with map layers that can be explored in the environment and downloaded in machine-processable format from the environment for subsequent work (e.g., for designing). • Display of 3D building information model that can be placed on the registered immovable layer. An image is created also of the building's location in relation to the buildings on adjacent registered immovables. The view contains also information on existing utility networks, information on performed inspections/maintenance of utility networks, information on renovation/reconstruction documentation if it is available. Composition of the information issued in the public view is limited, and the options of altering and customizing the displayed view are restricted. Services of informative materials include the following: • Overview of the legal acts, regulations and standards that are relevant for the user (including informative materials that are considered to have importance on the basis of the user's needs). Informative materials offered by third parties are not directly accessible from the platform – the platform directs the user to the original source (e.g., Estonian Centre for Standardisation, State Gazette). • Manuals, samples, forms and guidance materials that have relevance for the user. The public view also contains the section of information portal that aggregates field-related news and success stories, and its goal is to establish unified information field for the participants of the construction sector and to raise general awareness. **The authorized view** The authorized view displays a wider selection of services that include information retrieval services, information input services, proceeding, monitoring/surveillance, My Project view, informative materials and other services. Information retrieval services are analogous to the public view. Information input services include the following: • Data entry for applying various permits and approvals, and information exchange (including automatic retrieval from the information model). Information input services are largely also covered by proceeding. Proceeding • The service is mainly meant for officials of the state and the local government who deal with issuance of permits and verification of documentation.

	STAGE	DESCRIPTION
		Monitoring/surveillance • The services mainly include the inspections conducted during building maintenance. My desktop • The user has the opportunity of creating on the platform a folder that is related to a particular project, which enables to save and sort the information that is retrieved and stored on the platform. • The user is able to manage and alter the rights of third parties to see detailed data and to use the services under the scope of the objects belonging to the user. Services of informative materials are analogous to the public view. Other services • These enable the public sector users to create additional interfaces to their systems and to develop supplemental information sharing options. All information input services follow the principle of one-time data input, which means that previously entered data can be used as source data.

3.4. SECTIONS OF E-CONSTRUCTION PLATFORM BY SERVICES

The following overview describes functioning of the platform by the services offered. The description is based on the division of services reflected under the central view of the vision.

FIGURE 8. DIVISION OF THE SERVICES OF E-CONSTRUCTION PLATFORM



3.4.1. RELEASE OF INFORMATION

The public view and the authorized view of information retrieval services are distinct. Information retrieval service is used in the public view mainly by private persons who are interested in a particular registered immovable and/or building, but do not wish to receive too detailed information about it. To a smaller extent, the users may also include developers who are searching for initial information in relation to their development project. Main users and stages of the building's life-cycle that correspond with the service are presented in the table below.

TABLE 3. USERS OF INFORMATION RETRIEVAL SERVICE AND STAGES OF THE LIFE-CYCLE

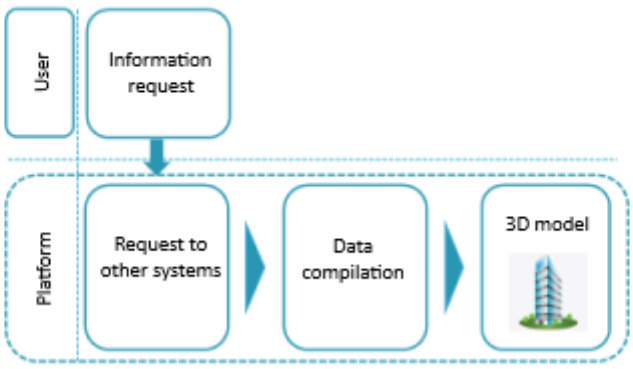
	Planning	Designing	Building	Utilizing	Buying/ selling	Demolishing
Developer						
Planner						
Designer						
Builder						
Maintainer						
Private person						
Local government/ state						

Information retrieval service consists of three main data sets.

- The first data set that is displayed to the user concerns plans that are related to the selected registered immovable (including comprehensive and detailed spatial plans), utility networks present on the registered immovable, existing restrictions, encumbrances.
- The second data set that is displayed to the user concerns information on the adjacent registered immovables of the selected registered immovable(s), including existing buildings, plans, known developments.
- The third data set that is displayed to the user concerns the main information on the building(s) located on the selected registered immovable. When it comes to the building, the display encompasses information on the presence of utility systems, information on inspections and maintenance and information on reconstruction documentation if it is available.

The precise composition of data sets and their inter-combining options will be established during the development of the platform.

FIGURE 9. LOGIC OF INFORMATION RETRIEVAL SERVICE



Prerequisite of releasing information in 3D view is the availability of all necessary source data in machine-readable format, including the modifiable 3D view of the whole built environment.

All data sets are displayed to the user in an uniform 3D view, which represents the combined information collected from various sources as layers and enables to use filters. The platform displays the information even if certain data are not available (e.g., when the registered immovable does not have detailed spatial plan). The users will have the opportunity of placing the planned building into the view reflecting the information on the registered immovable in order to assess the building's suitability into the environment and compliance with the restrictions.

FIGURE 10. EXAMPLE OF PLACING THE PLANNED BUILDING INTO THE ENVIRONMENT

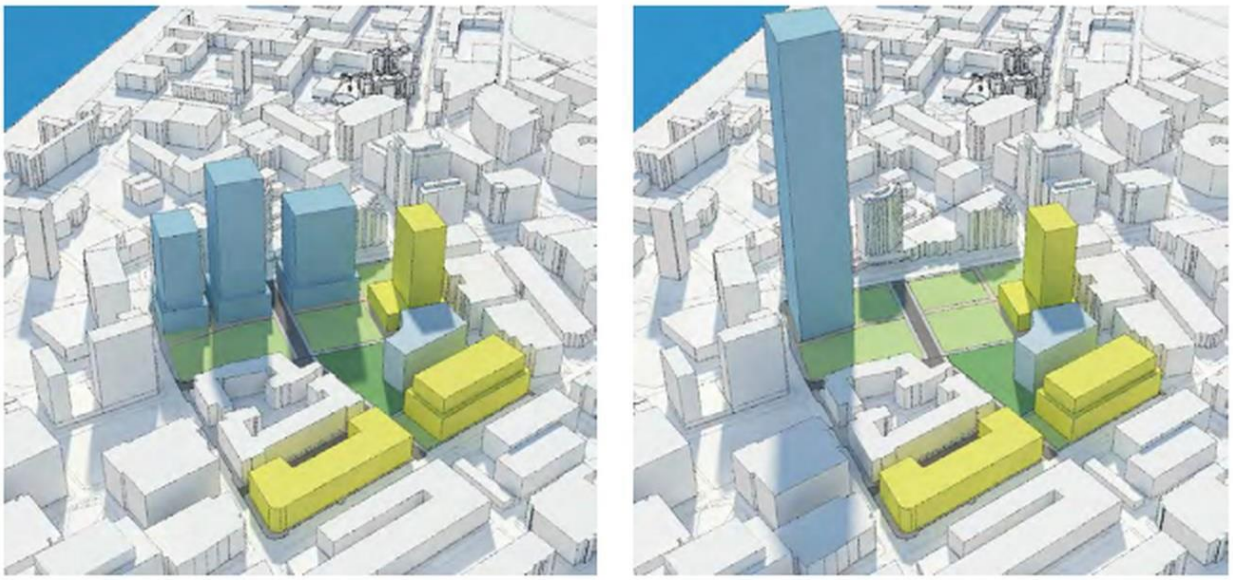


Image source: https://johnsanzone.com

In case of an existing building, the user has the opportunity to examine the main parameters of the building. Building information model is presented in an open format, and the user is able to download it and process it further in his/her own environment.

In comparison with the information retrieval service of the authorized view, the public view has limited volume of the displayed data and it reflects only the data that is legally available to the public.

3.4.2. INFORMATION INPUT

Users of information input service may include all parties of the life-cycle, but the main users and their relation to the stages of the life-cycle are presented in the table below.

TABLE 4. USERS OF INFORMATION INPUT SERVICE AND STAGES OF THE LIFE-CYCLE

	Planning	Designing	Building	Utilizing	Buying/ selling	Demolishing
Developer						
Planner						
Designer						
Builder						
Maintainer						
Private person						
Local government/ state						

Information input services are mainly meant for submitting the information serving the public interest, and for communication with the local government and state institutions. The user has the opportunity of

performing all activities (e.g., paying the state fee) via the platform. Information input services require authorization of the user.

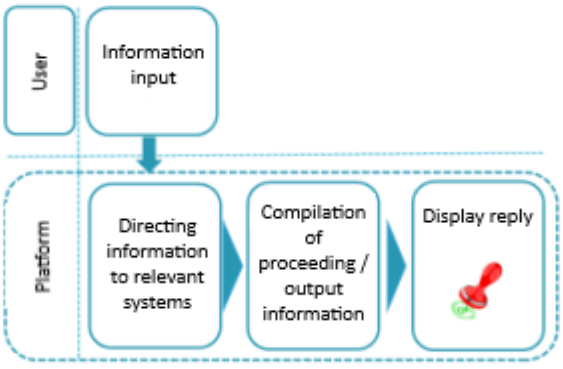
Information input services include the following sub-services:

- Activities related to adoption of a detailed spatial plan
- Applying for design specifications
- Applying for technical specifications
- Applying for a building permit or submission of a building notice
- Submission of building design documentation
- Importing construction documents (including the building information model) into the system
- Submission of the construction commencement notice
- Applying for a use and occupancy permit or submission of a use and occupancy notice
- Submission of information on technological inspections and maintenance performed within the scope of up-keeping the building
- Preparation of the energy label
- Saving the building's audit records, expert assessment reports of the building design documentation and the precepts

The list of sub-services is not final and will be augmented during development of the platform when new services are added.

Entered information is transferred through the platform to the relevant system that is used for exchanging data in order to complete the proceeding process. The view does not change for the user and the proceeding process that is performed in another system is not visible to the user. All information that is necessary for the user is displayed on the platform.

FIGURE 11. LOGIC OF INFORMATION INPUT SERVICE



Main principles of the information input service are the following:

- Initiating proceeding processes, applying for notices and permits, and entering information about a building takes place on the basis of information model and is automatic. Users of the platform can interface their systems with the platform in order to simplify the operational processes. Interfacing opportunity will also be given to the utility network operators among others. All necessary data move through the platform in machine-readable format and are promptly available to the users.
- Information about buildings is added to the system in an open format that does not contain all the data that is reverberated in the information model.
- Upon entering the data, the user is able to choose which parties can access the relevant information. Thereby the user can set limits on which information is publicly displayed and which information requires giving additional rights to a particular party. It will be defined on the platform which information is presented in public interests and submission of which to the state institutions is mandatory, and which data belong to the category of other information.

- Users of the platform can constantly monitor the status of the initiated proceeding processes, and they will have an overview of the responsible official. Within the scope of the process, the platform provides the users with the remarks and additional questions of the official(s) conducting the proceeding. The platform notifies the user automatically about submission of remarks or issuance of the permit/notice.
- Information that is released during the proceeding process is automatically added to the object, and the object will be flagged also upon refusal of issuance of the permit.

3.4.3. PROCEEDING

Proceeding services are mainly meant for the officials of the local government. Utilization of the service presumes authorization on the platform. Proceeding services include the following proceeding processes:

- Activities related to adoption of a detailed spatial plan
- Disclosure of design specifications
- Issuance of a building permit or verification of a building notice
- Issuance of a use and occupancy permit or verification of a use and occupancy notice
- Execution of state supervision during building and utilization of the building
- Market surveillance of building products

The following table gives an overview of the users of the service and the position of the service in the building life-cycle.

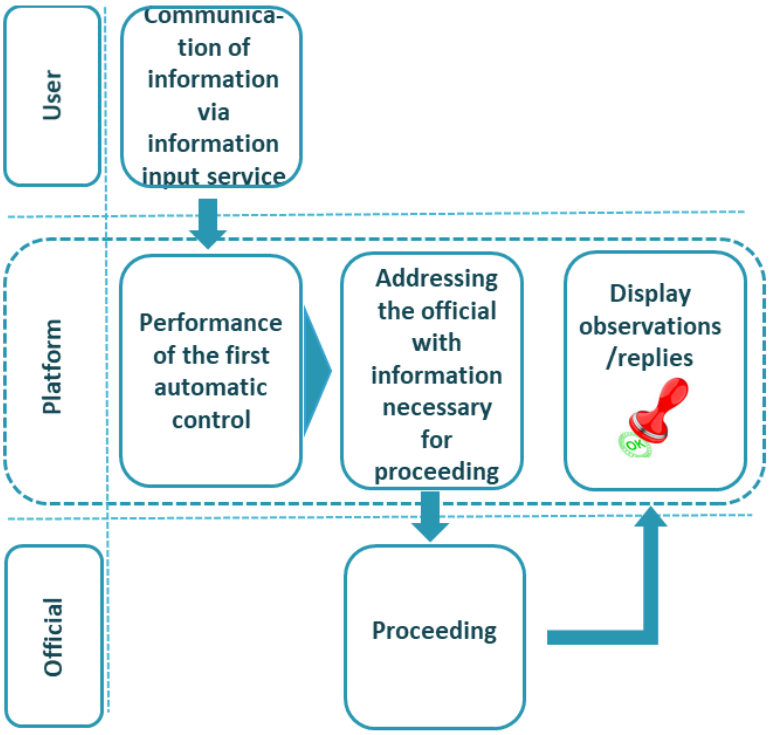
TABLE 5. USERS OF PROCEEDING SERVICE AND STAGES OF THE LIFE-CYCLE

	Planning	Designing	Building	Utilizing	Buying/ selling	Demolishing
Developer						
Planner						
Designer						
Builder						
Maintainer						
Private person						
Local government/ state						

Utilization of the service requires interface with the respective system that stores information which is necessary for proceeding processes and is created during the proceeding.

Data that are necessary for the proceeding are automatically read into the system within the scope of all proceeding processes. The system also performs automatic verification of the initial application and building information model in order to assess if the data comply with applicable requirements. This reduces the burden of the official conducting the proceeding and the amount of mistakes, and increases the extent of substantial verification. The system stores a log of the proceeding process that indicates when and which decisions have been made.

FIGURE 12. LOGIC OF INFORMATION MOVEMENT OF PROCEEDING SERVICES



All decisions made during proceeding processes, proposals for improvements and remarks are displayed in the user view on an ongoing basis, which ensures transparency and efficacy of proceeding processes.

3.4.4. MONITORING/SURVEILLANCE

Monitoring and surveillance services are mainly meant for those officials whose duty is to monitor building maintenance during utilization of the building.

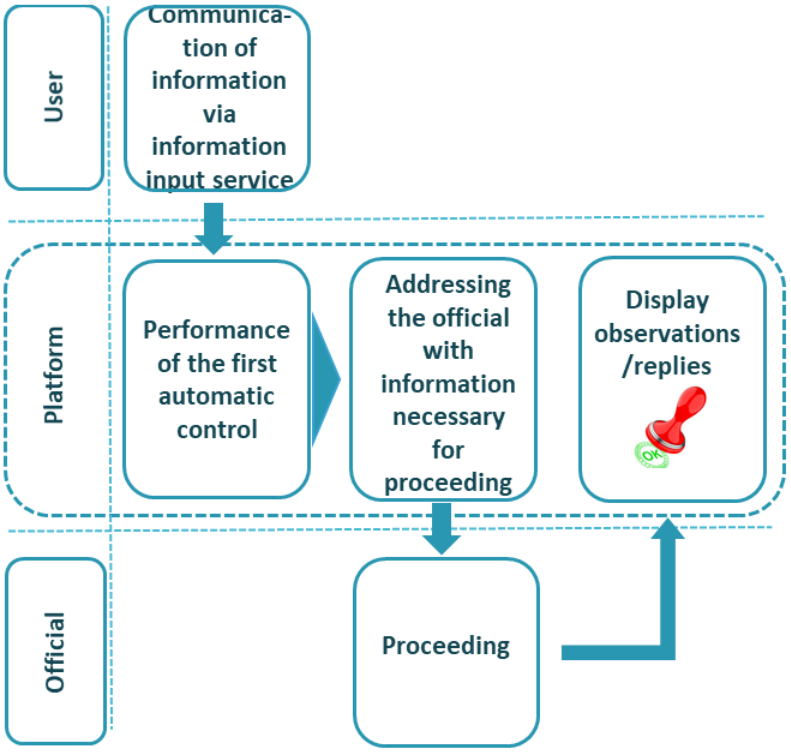
TABLE 6. USERS OF MONITORING/SURVEILLANCE SERVICE AND STAGES OF THE LIFE-CYCLE

	Planning	Designing	Building	Utilizing	Buying/ selling	Demolishing
Developer						
Planner						
Designer						
Builder						
Maintainer						
Private person						
Local government/ state						

The module of monitoring and surveillance enables to obtain an overview of object-related monitoring and maintenance obligations. Reports of object-related monitoring, mandatory maintenance and surveillance are enclosed to the object. This means that the object is supplemented with information on which maintenance procedures have been performed, and interested parties will have the opportunity to examine the object's maintenance history.

Logic of information movement of monitoring and surveillance services is similar to the logic of information movement of proceeding services. Responsible official can access the information on the performance of maintenance and inspection that is added to the platform, and has the capability of giving it his/her approval. Respective approval is automatically displayed to the user.

FIGURE 13. LOGIC OF INFORMATION MOVEMENT OF MONITORING AND SURVEILLANCE



Prerequisite for the functioning of the service is interfacing the environments of respective agencies and authorities with the platform. The platform is used for arranging information exchange, but the information is stored in the system of the relevant authority.

3.4.5. MY PROJECT VIEW

My Project view of the platform enables the users to save into their views/folders all significant information, including extracts from requests for information, information models, important documents and guidance materials. Users can also share their materials with other parties in My Project view. Utilization of My Project view presumes authentication on the platform, and creation of the project is object-based.

3.4.6. INFORMATIVE MATERIALS

Informative materials contain references to all legal acts that are available in the State Gazette and apply to the building life-cycle. The user is also provided with the display of standards of Estonian Centre for Standardisation, samples of initial briefs, necessary forms, best practices and guidance materials. There is a difference between the public view and the authorized view, as the latter enables the user requesting the informative materials to subscribe for notifications of alteration of important requirements.

3.4.7. OTHER SERVICES

The section of other services enables to interface with the platform services that are developed by the private sector. Other services will also involve potential services which prove to be necessary within the scope of platform utilization, and provision of which is deemed to be important. Integrable services can be:

- Focused on information input – one example involves supplementing the permit application with building-related documents from the project management software.
- Focused on information requests – the service utilizes the platform mainly as the data source for offering additional services to the user.

4. DESCRIPTION OF FOCUS FIELDS

In order to attain the strategic objectives of this vision, it is important to place emphasis on the following focus fields.

FOCUS FIELD 1: EXISTENCE OF HIGH-GRADE UNDERLYING DATA

This focus field is centered on ensuring the existence of high-grade underlying data that are necessary for the functioning of the platform. In order to commission all services of the platform in the described extent and way, it is necessary to convert all underlying data to a format that enables to machine-process them. In addition, it is important to guarantee reliability and accuracy of the underlying data. Development of the platform provides a high-quality and efficient infrastructure that enables to use the data that derives from various information systems and databases in one environment. Existence of high-grade underlying data also refers to the need of converting information on comprehensive and detailed spatial plans, borders of registered immovables, object-related utility networks and other infrastructure and restrictions to a machine-processable format.

From the viewpoint of ensuring usability of the platform, it is important to define the public interest and to determine the resultant composition of the data sets provided.

FOCUS FIELD 2: TRANSFORMING EXISTING SYSTEMS FOR COMPLIANCE WITH UNIFORM PRINCIPLES

In order to ensure service-based functionality of the platform under establishment, it is necessary to convert other existing systems to a similar service-based architecture, which guarantees information exchange between the systems and the platform. The platform enables to retrieve and use data that derive from very different databases and information systems, and functionality of the platform hence depends on the interface between the systems and the platform, and feasibility of data exchange.

FOCUS FIELD 3: CREATION OF UNIFORM CLASSIFICATION SYSTEM

From the viewpoint of ensuring the functionality of e-construction platform, important role is also placed on the uniform classification system that is currently being developed[5]. Creation of unified principles and agreements is one of the most important pillars of digital information exchange. Creation of a classification system that supports and describes construction processes and construction information has vital importance to enable fast, efficient and high-grade information movement between the parties of Estonian construction sector.

FOCUS FIELD 4: PROMOTION OF INTRODUCING NEW WORK METHODS

Most important factors for increasing the productivity of the construction sector include expansion of collaboration between the parties of the sector, and companies' utilization of innovative solutions. Thereby it is necessary to raise the awareness of the parties of the sector, including the contracting entities. For example, integrated project management method would increase the speed, efficacy and quality of the construction process, but this presumes that the contracting entity is willing to handle the costs across the life-cycle, and the stages of the life-cycle are separately optimized only when it does not affect the expenses occurring throughout the building's lifespan. Integrated project management raises the quality of information exchange between the contracting entity, the developer, the designer and the builder, and ensures involvement of important parties at an early stage.

FOCUS FIELD 5: FOSTERING THE DEVELOPMENT OF FIELD-SPECIFIC EDUCATION SYSTEM

Ensuring smooth digital information exchange and the willingness of the parties of the sector to implement new principles presumes paying attention to promoting the competence of the sector's employees. At the moment, Estonian designers use information models to a relatively large extent, but utilization of information models is not yet wide-spread among the builders (especially the sub-contractors) and administrators. One reason lies in the employees' lack of competence that is necessary for using information models.

Second aspect that concerns the education system regards ensuring that sufficient amount of employees with professional education enter the market. In particular, the number of people graduating from

[5] Classification system is being developed in collaboration with TalTech, and the system will presumably be ready by autumn of 2020.

engineering-related specialties is currently not adequate for covering the market needs.

Covering the manpower needs of personnel with professional qualification requires multidisciplinary systemic branding in collaboration of enterprises, professional associations, educational institutions and the state, which enables to establish the development opportunities of the construction field in general, to increase the motivation to engage with studies on construction-related specialties, and to support progeny of teaching staff and proliferation of professional competence. Attention should be paid to reduction of discontinuation of studies, which mainly presumes creating opportunities for combining learning and working more flexibly, and making the studies more practical.

Wider implementation of BIM entails the need of developing the knowledge on utilization of BIM software and BIM processes, and offering respective in-service training, particularly to the working engineers, architects, surveyors and construction managers[6].

[6] SA Kutsekoda. Tulevikuvaade tööjõu- ja oskuste vajadusele: ehitus. 2017

5. THE PROCESS OF IMPLEMENTING, UPGRADING AND MODERNIZING THE VISION

This chapter provides an overview of implementing, upgrading and modernizing the vision. In addition, the chapter defines the parties responsible for implementing, upgrading and modernizing the vision, and intervals applying to the process.

The principle of plan-do-control-act (PDCA) cycle is the basis of the process of implementing, upgrading and modernizing the vision. Utilization of the principle involves constant monitoring of implementation of the established vision, and carrying through subsequent amendments and additions.

The Ministry of Economic Affairs and Communication is responsible for **IMPLEMENTATION OF THE VISION**. Implementation is grounded on the activity plan (road-map) that is attached to this vision paper. The activity plan explains the activities necessary for attaining the objectives and provides a timetable for conducting them. The activity plan contains the descriptions of the activities of all parties that are related to the development and implementation of the platform, interim deadlines of performing them, and the intended results. The created activity plan is reviewed at least once a year, and additions and alterations will be introduced to the activity plan when necessary.

The Ministry of Economic Affairs and Communication is responsible for **UPGRADING AND MODERNIZING THE VISION**. The vision is upgraded and modernized on the basis of the principle of needs-based approach. The principle of needs-based approach will be determined during the review of the activity plan for implementing the vision. The input required for upgrading and modernizing the vision will be obtained from the parties of building's life-cycle. Input for upgrading and modernizing the vision will also originate from alterations in regulations, standards, legal acts and strategic documents. When necessary, parties of the sector and stakeholders will be engaged in upgrading and modernizing the vision.

6. THE NEED OF ALTERING REGULATIONS

The interconnection between the vision and national and international strategic documents is also discussed in chapter 5 of the background document attached to the vision. The goal of this analysis is to bring out the changes in laws and other legal acts governing the field that would be necessary for implementing the vision. The chapter is concise and does not contain a profound analysis of all necessary alterations, and establishment of the platform hence requires performing a supplementary and exhaustive analysis of the legal system.

Legal acts governing the field do not promote at the moment the introduction of digital solutions, but also do not impede it directly. **Legal acts have not been compiled in view of the logics and processes of digital solutions**; regulations do refer to digital documents, but in majority of the cases they do not differ substantially from documents on paper media. Most important Estonian legal acts concerning the field of construction and planning **do not reflect nor govern the need or requirements of preparing building information models**.

Implementation of the vision involves a transition period, which enables to utilize current document-based processes and the updated data-driven processes. Therefore, requirements that are used in parallel should be taken into account on altering the legal acts.

Ensuring consistency between the vision and legal acts concerning creation, management and proceeding building-related information presumes paying attention to the following aspects.

- Requirements on the data content – legal acts should define the minimum requirements on the composition of the presented information, which enables to achieve the goals established with the development of the portal. For example, it is necessary to stipulate which classification system should be used on preparing the building information model, and which data layers and level of detail should be used on applying for the building permit. It is thereby necessary to take notice of geometric and non-geometric information.

  As information available about buildings will be more detailed with model-based data exchange, it is necessary to define information that is available to the public and information with limited access so that it would not prejudice the interests of the owner of the builder.

- Requirements on data formats – legal acts should define machine-readable data formats that would be suitable for submitting various types of documents. For example, IFC or LandXML formats should be used when building design documentation is presented as information model.

- Principles of creating information – in addition to strict requirements on data composition and formats of data exchange, the structure of legal acts should also be analyzed as a whole. Thereby, it would be recommendable to transit from the approach that is currently mainly grounded on document-based outputs to the data-driven approach of creating information, which would entail an opportunity for flexible introduction of new and developing information presentation methods.

Most important legal acts concerning creation, management and proceeding building-related information are the following:

- **The Building Code and its implementing acts**
- **The Planning Act and its implementing acts**
- The act to implement the Building Code and the Planning Act
- Regulation “Constitutive regulation of the register of construction works” of the Government of the Republic
- Regulation “Constitutive regulation of the register of roads” of the Government of the Republic
- Regulation “Requirements of documenting construction works, preservation and transfer of construction documents, and requirements applying to maintenance instructions and their retention and submission” of the Minister
- Regulation “Requirements for building design documentation” of the Minister

- Regulation “List of technical specifications concerning construction works and the principles of calculating these specifications” of the Minister
- Regulation “Formal requirements of notifications, building permits, use and occupancy permits and their applications and the procedure of submitting notifications and applications” of the Minister
- Regulation “Requirements applying to road building design documentation” of the Minister
- Regulation “Requirements of the expert assessment of building design documentation” of the Minister
- Regulation “Requirements applying to topographic and geodetic surveys and as-built surveys” of the Minister
- Regulation “Requirements applying to geotechnical investigations” of the Minister
- Regulation “The procedure of auditing construction works” of the Minister
- Regulation “The procedure of performing owner’s supervision” of the Minister
- Regulation “Formal requirements of applications for design specifications and the form of design specifications” of the Minister
- Regulation “The list of the purposes of use of construction works” of the Minister

Current legal acts contain partial references to building information models, but these are insufficient for establishing the model-based data exchange as a standard. Regulation “Requirements for building design documentation” mentions utilization of 3D models in general term, and permits to add virtual models or 3D models to building design documentation. Regulation “Requirements of documenting construction works, preservation and transfer of construction documents, and requirements applying to maintenance instructions and their retention and submission” stipulates that IFC information models and formats should be used on preparation of a digital model of a building.

As local government in the manager of important information during the building’s life-cycle, it is necessary to ensure consistency between the vision and field-specific legal acts of local governments (e.g., construction regulation of Tallinn) in addition to national legal acts and laws.

Usability of e-construction platform depends significantly also on the relevance and (legal) reliability of the available information. If the professional user (e.g., the designer or the architect) does not entrust the data downloaded from the platform (e.g., design specifications or the map of restrictions in the format of information model), the platform does not serve its purpose and the user is still burdened with additional work of verifying the accuracy of the data. It is important to define who is responsible for the relevance of data and to what extent. On the other hand, excessively strict liability requirements would inhibit utilization of the platform because participants would not be interested in adding data to the platform if this could result in too stringent sanctions. These aspects require thorough analysis on development of the platform.