

Digitisation of the construction planning in Poland

IT platform for BIM – report with recommendations

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Comments

The text in bold, marked **IN ORANGE** means information which, in the opinion of the authors of this study, is particularly important.

1

Introduction



1 Introduction

1.1 Scope of the study

This document is a technical report within the project "Digitisation of the construction process in Poland" in the field of ICT solutions (information and communication technologies) supporting the use of BIM in public procurement.

The report has been prepared based on information obtained from the European countries and the home market. Due to the intended use of the proposed solutions - for the Polish construction market - the domestic legal (especially the Public Procurement Law) and organizational conditions were particularly important. At the same time, the needs of the market and its readiness to effectively use IT tools were considered.

In the first part of the report, based on source materials such as: questionnaires, industry reports, conclusions from previous consultations and other publications available on the market, solutions applied by the construction industry in Europe and Poland were identified. Next, the possibilities of their use within the scope of investments carried out in the formula of public procurement using BIM in Poland were analysed.

In particular, the results of the survey carried out in February 2020 as part of the Project, which was addressed to Project stakeholders present at the consultation meetings of previous project deliverables and other participants of the Polish construction market, were significant. The aim of the questionnaire was to gather information about the use of IT systems, to define the scope of their use and the level of industry experience.

As part of the work, a meeting was held with representatives of the Public Procurement Office to obtain additional information about the e-Procurement platform (this information was included in the analysis presented in chapter 2.5.3) and to present the results of a preliminary analysis of the considered directions of implementation of IT solutions supporting the Polish construction sector in application of the BIM methodology in public tenders.

Suggestions and comments provided by Project stakeholders during meetings with representatives of the Beneficiary and the construction market invited to consultations (investors, designers, consultants, contractors) were also taken into account in the analysis of the report.

The questions raised by the participants of the meetings about the issues of market neutrality and objectivity of the information contained in the platform were also taken into account by providing substantive care by a platform developer specializing in BIM. The information contained in the BIM IT platform will be verified by the entity or person(s) indicated by the contracting authority.

The second part of the report presents a description of the situation that should arise in the future so that stakeholders involved in the implementation of the BIM methodology, as well as those implementing projects in accordance with this methodology, can use a system that supports BIM processes. In this way the initial and final boundary conditions for further parts of the report are defined.

1.2 Development of digitisation

According to Deloitte experts [1] Central and Eastern European companies have mastered the effects of the economic crisis at the turn of the last decade and are now claiming to be leaders in modern technologies. When we compare the innovation indicators for 2011 and 2019, we observe that most countries are developing and performing better. [2]. The leaders and countries with the highest innovation rates are mainly Scandinavian countries, the UK and Western European countries.

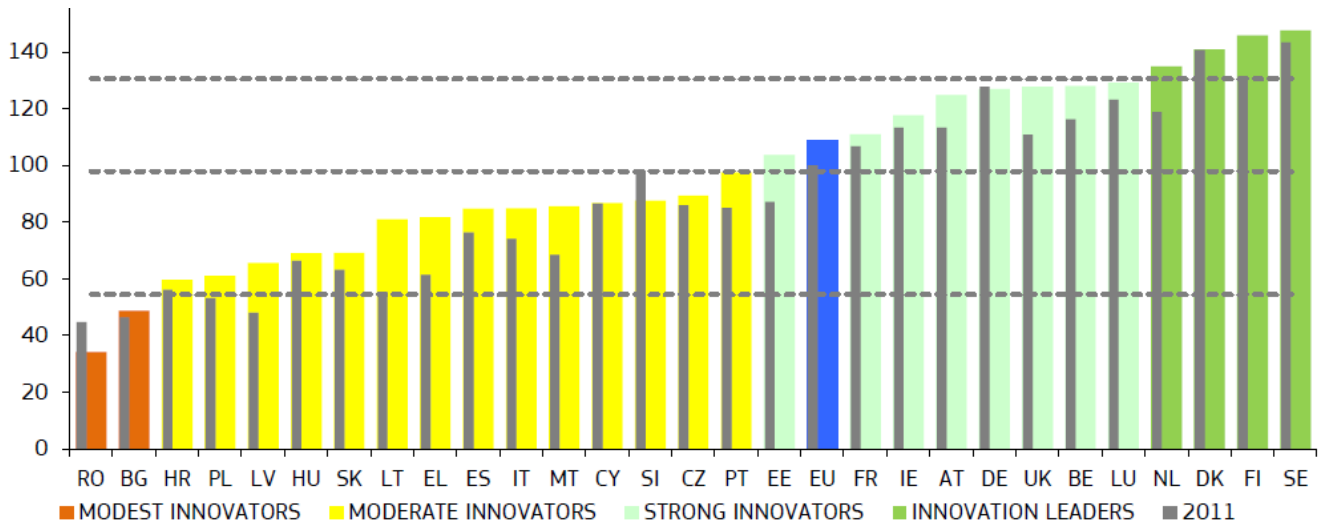


Figure 1 Innovation indicator of EU Member States

The source: [2]

In order to gain a competitive advantage, companies must be able to adapt quickly and react to the high pace of change and invest in technological development. There is an increasing emphasis on the digitisation of the design stage, especially in large construction companies, which have enough resources to use innovative technologies.

Digitisation is changing the way designers, investors and contractors work and communicate. As indicated in the NBS (National Building Specification) report of 2019. [3] Nearly 90% of the questionnaire respondents in the UK believe that digitisation will completely change their way of working, and 70% agree that companies that do not adopt digital working methods will stop operating in the market.

In Poland, over the recent years, there has been a dynamic development of information technology and digital transformations taking place in the construction industry. According to the report "Innovation in construction 2020" conducted by BauApp and ConQuest[4] It is digital solutions that will accelerate the development of innovation in Polish construction industry. In order to transform the organization into a capable of development, modern technology, cloud solutions, control and digitalization of the organization's processes should be used. Not all solutions are possible to implement in the short term, many of them should be planned well in advance, but they are necessary to adapt to the changes taking place and build a competitive advantage¹.

¹ Source: <https://www.pwc.pl/artykuly/efektywnosc-operacyjna-czyli-droga-do-organizacji-zdolnej-do-wzrostu.html>[access: June 2020].

2

Current state of IT systems. Analysis and conclusions



2 Current state of IT systems. Analysis and conclusions

The analysis of the current assets and use of ICT tools by the construction industry, both in European countries and in Poland, has been divided into groups, according to their function.

The first group consists of **BIM TOOLS**, including solutions dedicated to the creation, coordination and verification of models and a model browser. However, in order to discuss IT systems as a whole, apart from the mentioned sets of tools directly supporting the design and management, which are only a part of the IT system, one cannot omit project management and running tools (which in relation to BIM are known as CDE²). These are the second group of tools analysed.

The third group is made up of **BIM PLATFORMS** to support the changes in the organisation as a result of the BIM adoption. This term in this study should be understood as websites that are databases of knowledge and information exchange, containing various types of guidance, aids, dictionaries and collections of good practices. Blogs and other websites run by software producers focused on the possibilities of specific tools are excluded from the subject of the study.

The last group includes **PROCUREMENT PLATFORMS** (in this document also referred to as e-services), which are a group of business services and other services of a technical-administrative nature, provided electronically and enabling the execution of public procurement procedures[5].

Due to the nature of the Project, the work within this phase has been based on solutions provided by governmental and non-profit organizations.

2.1 BIM tools for model creation, verification and coordination

2.1.1 Foreign market - selected European countries

The basic group of BIM software is made up of tools that enable models to be made, reviewed, coordinated and verified. They are the most numerous groups of BIM tools. This year's British National Building Specification report [6] shows significant variation in both modelling programmes (and manufacturers), model browsers and model verification programmes. Although the report does not analyse what percentage of respondents use BIM tools, it shows that this sector is highly fragmented. This is not expected to change soon. The growing popularity of BIM software is clearly visible - among the five most used design tools, they have the largest market share (see Figure 2).

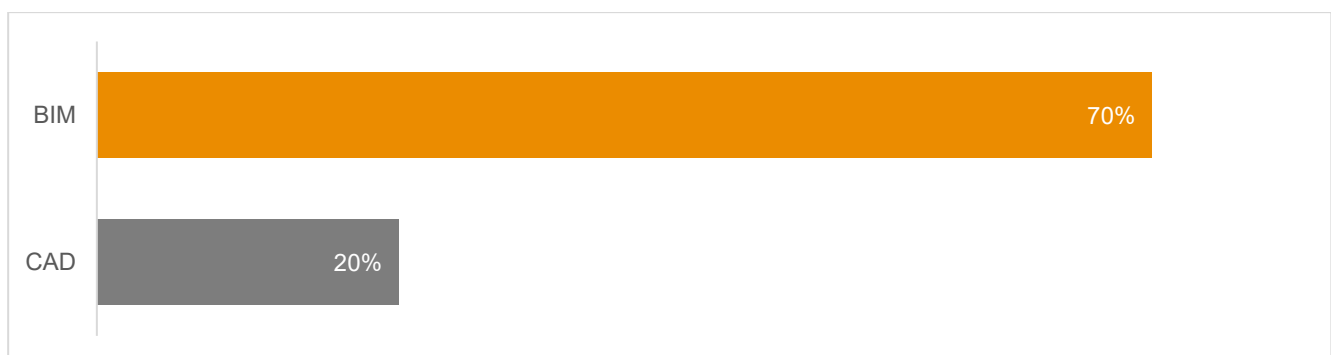


Figure 2. Share of CAD and BIM software in terms of the most used design tools
Source: Own study based on [6]

² Common Data Environment - An agreed source of digital information for a designed or existing 'resource' used to collect, manage and disseminate the associated 'information containers' in a managed process.

The diversity of the software forces the use of open data exchange formats, which make the participants of the investment process independent of specific manufacturers and enable the cooperation of various tools. This solution has been used for many years³ and the percentage and popularity of this solution is constantly growing (see Figure 3).

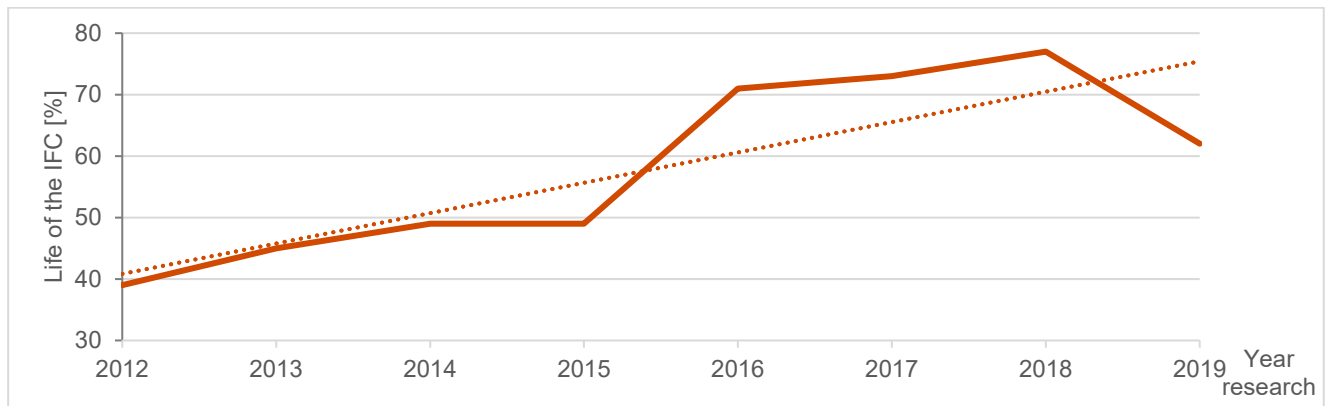


Figure 3. Increase in use of IFC format in the UK according to NBS reports
Source: Own study based on NBS 2012-2019 reports

Also, in Spain, the use of IFC is increasing, as shown in Figure 4. This is because BIM is mandatory for volume and line investments from December 2018 and July 2019 respectively.

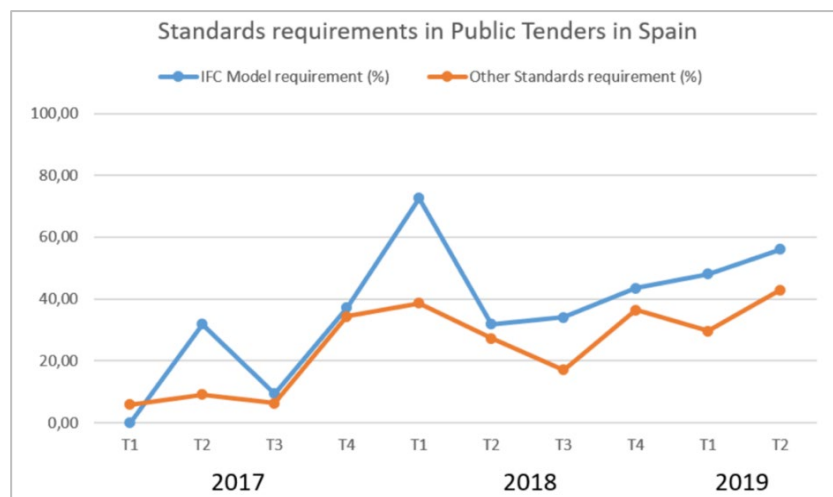


Figure 4. Use of IFC format and other BIM requirements in Spain in public tenders
The source: [7]

The Scandinavian countries have been successfully using the IFC format for years. Finland introduced the IFC certification requirement for all design programmes in 2007; in Norway, the IFC format has been used in all Statsbygg⁴ projects since 2010.

From the above data⁵ it can be concluded that the IFC format is already well established in Europe.

2.1.2 Poland

In Poland, there is a lack of such consistent data as in the UK on the use of BIM tools. The data contained in the reports do not allow for long-term analysis, the selection of a sample of respondents also does not allow for the assessment of general trends. Therefore, the results of a survey conducted in one of the previous stages of the Project were mainly used in the research of the Polish market.

³ When considering the open data formats for BIM, the IFC format was cited, which was introduced in 1997.

⁴The Norwegian Directorate of Public Construction and Real Estate.

⁵Source: <https://www.geospatialworld.net/article/bim-adoption-around-the-world-how-good-are-we/> [access: June 2020]

According to them, 60% of the respondents declared that BIM class tools are used in their organization. They are most often used at the design stage (86%), followed by investment planning (47%) and implementation (38%). Only 6% of the respondents use BIM tools at the facility management stage.

The modelling tools are found in the organization assets of 68% of respondents. Most of them (66%) indicated that they are used almost daily, but almost 4% of respondents said that although the software is in the resources of the organization, it is not used (see Figure 5). This fact is particularly puzzling since the cost of software is the most frequently indicated barrier to BIM implementation both in an organization and in Poland (this factor was indicated by 26 and 20% of respondents respectively). It should be noted, however, that the cost of BIM design software is largely dependent on the manufacturer and the purchase option (currently there are perpetual licenses and subscriptions/leases for various periods of time - from one month to 3 years) and vary from several to several thousand zlotys per year. For comparison, the cost of CAD⁶ software starts within one thousand PLN.

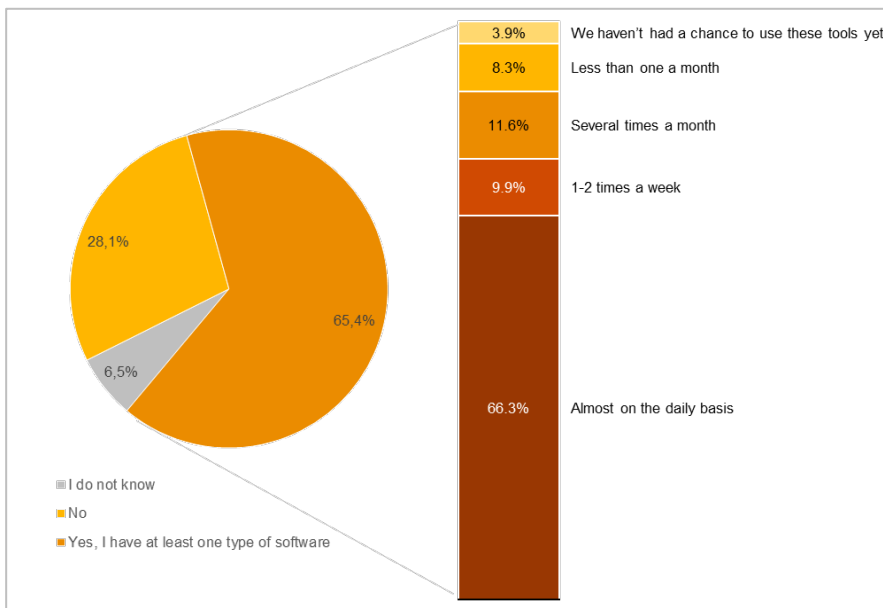


Figure 5. The results of the questionnaires carried out within the scope of this Project illustrating the assets and use of tools for creating models

Source: Questionnaire conducted under the Project

Tools for coordination and verification of models can be found in the organization assets of 42% of respondents. In most cases they are used several times a month or more often (a total of 83% of the above group of respondents). Nearly 7% of the respondents indicated that they do not use their tool.

Almost every fourth respondent (24%) indicated that his organization's assets include tools for valuation, scheduling or facility management based on the BIM model. The frequency of using this software varies. Almost 20% of the respondents indicated that they had not yet had the opportunity to use the purchased tools.

Slightly more than half of the respondents declared that BIM model browsers are used in their organization, of which 4% indicated only paid browsers. Four out of ten respondents say that BIM browsers are not used at all in their organisation.

2.1.3 Analysis and conclusions

The Polish construction market is similar to other European countries in terms of resources to BIM tools. The construction industry noticed the potential of new BIM tools at least several years ago. Additionally, top-down activities are being carried out in order to coordinate the process of applying BIM in investments carried out under the public procurement formula.

⁶ Computer Aided Design.

When analysing the possibilities of designing new functionalities of tools for creating, verifying and coordinating models, several facts should be considered:

- The market currently offers many solutions dedicated to various stages of the investment process. Tools offered abroad can also be successfully used in Poland due to their versatility;
- The costs of software, although higher in Poland in relation to the value of average remuneration than in other EU⁷ countries, can be limited by choosing an appropriate licensing method for a given organisation (both perpetual licenses and the possibility of using the software in a shorter time are available). Assistance in obtaining preferential conditions for software purchase is also offered by various organisations, e.g. the Ministry of Development and the Ministry of Funds and Regional Policy as part of support programmes for small and medium-sized enterprises⁸, the Chamber of Architects of the Republic of Poland⁹;
- The BIM software sector is shaped by free market mechanisms – in order to meet the increasing expectations of BIM users, manufacturers are constantly developing their tools every year, introducing new or improving the operation of subsequent functionalities;
- Individual industries use different types of products that meet their specific needs - there is no single product that is optimal for all aspects of investment execution.
- The market for tools to create, verify and coordinate models is so rich that it covers the needs of the construction industry. Its self-organisation also leaves no room for top-down action - therefore the aspect related to this toolbox will not be raised again in this analysis.

2.2 Project management platforms

Project management platforms - in short referred to as CDE¹⁰ are an agreed source of digital information for a designed or existing resource (facility), used to collect, manage, and distribute related information in a managed process. The CDE should not be identified with specific software, as it can be a set of ICT solutions. The most popular BIM solutions are EDMS (electronic document management system) and MMS (model management system).

The most used tool - EDMS - is a system for storing, searching, sharing and managing documents in electronic form [8]. These tools usually have at least a few of the basic functionalities listed below, which cover most of the CDE recommendations of the ISO 19650 series:

- Possibility of storing documents in electronic form;
- Control of access to data stored in EDMS;
- Editing log (versioning, change preview, platform activity reports);
- Users are granted appropriate rights, which promotes transparency in investment management.

Many providers of EDMS solutions offer the possibility of extending the functionality with modules dedicated to project handling using BIM. These include model browsers (MMS), which, although not mandatory for CDE, are increasingly used. The sources of this trend can be seen in the growing popularity of BIM and IFC format. Increasingly, providers are also developing platforms with functionalities that allow communication based on model elements. In this respect, BIM collaboration format (BCF) or proprietary solution offering the same possibilities as BCF is most often used.

⁷ Source: <https://architectu.pl/aktualnosci/Jak-zarabia-architekt-w-Europie> [access: June 2020].

⁸ Source: <https://www.funduszeuropejskie.gov.pl/strony/skorzystaj/wsparcie-dla-mikro-malych-lub-srednich-przedsiębiorcow/> [access: June 2020].

⁹ Source: Resolution No O-32-V-2019 of the National Chamber of Architects of the Republic of Poland of 17 April 2019 on the appointment of the BIM Team.

¹⁰ See footnote **Error! Bookmark not defined.**, page 7,

2.2.1 International markets – selected European countries

Project platforms play an increasingly important role in the implementation of investments. This thesis is confirmed by the British NBS report [6] according to which a growing number of respondents use CDE platforms. Almost three quarters of respondents use them in their projects.

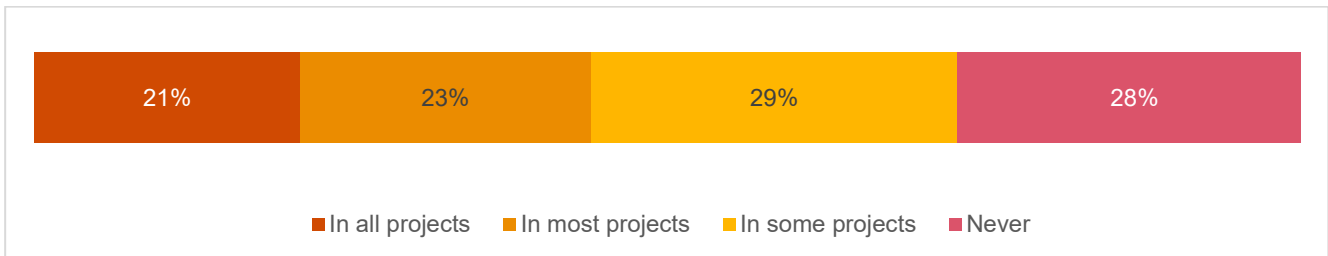


Figure 6 Use of CDE tools in project implementation
Source: [6]

However, it should be noted that, similarly to design and management tools, the market for project management tools is highly fragmented - at least a dozen or so tools with different capabilities and a noticeable market share can be distinguished. This situation is presented in Figure 7.

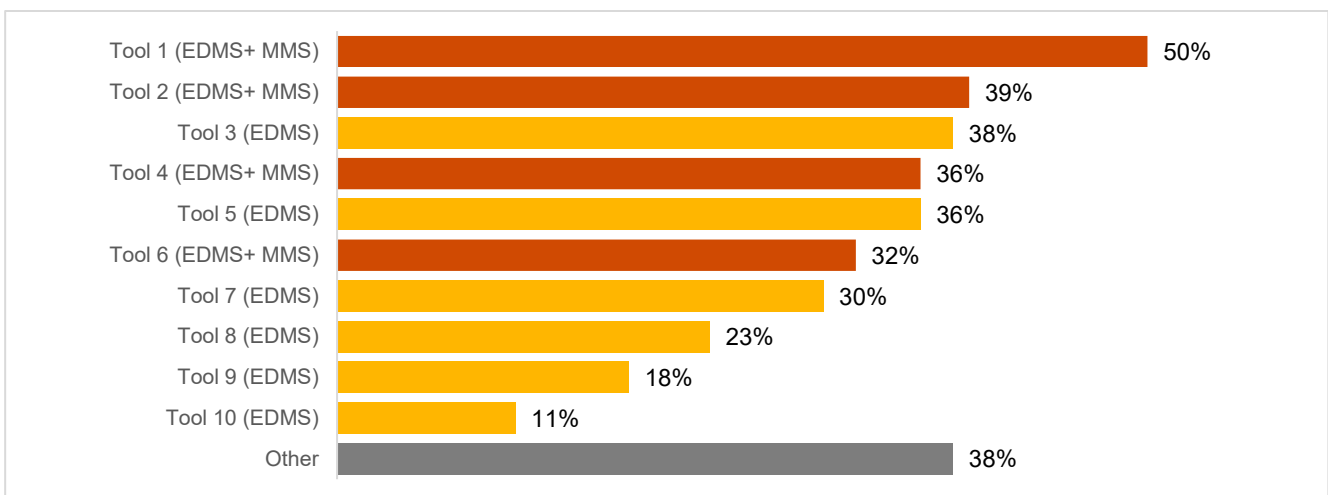


Figure 7. Most used management tools in terms of market share and functionality
Source: Own study based on [6]

2.2.2 Poland

In Poland, for several years now, there has been a growing interest in project management tools. This can be seen in the implementation of the provisions of Directive 2014/24/EU into the Polish legal system and the Public Procurement Law (PPL), which states that in the case of works contracts or design contests, the use of specific electronic tools, such as tools for electronic modelling of construction data or similar, may be required, as well as in the increasing number of orders using BIM in the public sector (and the consequent requirement to use the CDE).

According to the questionnaire conducted as part of the Project, the platform (or system) enabling collection and exchange of data for the Project with other participants of the investment process is in the resources of the organisation about 48% of respondents. Most often it is a repository used only to store and share data (29%, more than half of them are designers), a little less often it has additional possibility to display data, including BIM models (14%) or integrating data from different systems (11%). Less than 46% of respondents do not use the data exchange platform at all.

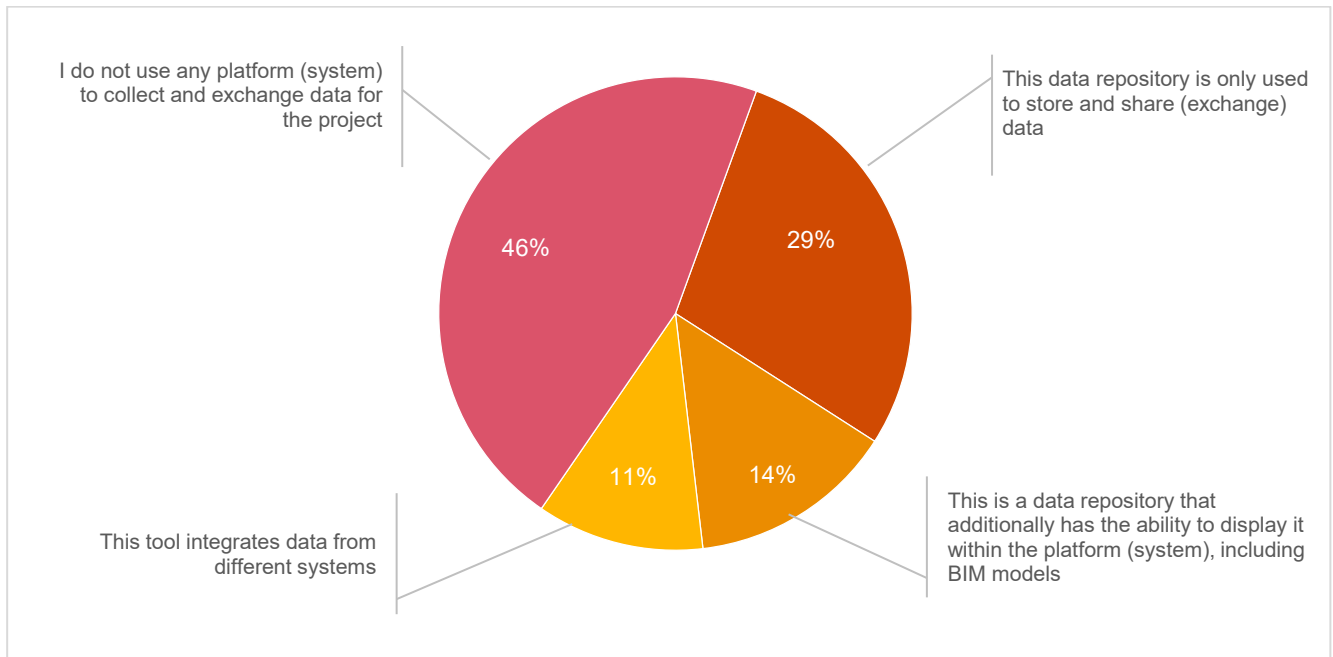


Figure 8 Use of platforms (systems) to collect and exchange data for the project
 Source: Questionnaire carried out under the Project

Most people who declared that their organisation uses a platform (or system) to collect and exchange data specified that only 0-25% of the projects are affected. Less than a quarter of the respondents who use such tools do so in most of their projects (in the range of 75-100% of the tasks performed). They are more than 55% designers.

23% of respondents of the architectural and construction industry declare the use of cloud computing technology. Of which 34% are architectural and design companies, 24% are construction companies.

Respondents with experience in using cloud solutions pay attention to easier communication (64%) and access to data from anywhere (63%).

As it is the case on the foreign market, in Poland CDE tools are also being extended with modules for handling models. Table 1 shows the most frequently required CDE functionalities in Polish tenders using BIM. This analysis has been performed in two groups of functionalities: EDMS and MMS.

Table 1. Most common functionalities of project management tools (CDE)

Project platform area (CDE)	Functions	
	Basic	Additional
Data repository (EDMS)	<ul style="list-style-type: none"> • Access to content via the Internet (software as a service) • Secure login with an individual login and password for each project participant • The ability to store data in project-specific formats • Statement of compliance with ISO/IEC 27001 or certificate of compliance with the aforementioned standard • Ensure that the data stored in the EDMS can be archived 	<ul style="list-style-type: none"> • Servers located in the European Union (the requirement has its source in the GDPR Act) • Possibility to determine user access levels to particular areas of EDMS content • Revision system for data stored in EDMS • The possibility of establishing document circulation paths within the procedures established for the project • Linking to external applications or services, such as mobile • Activity notifications (file addition, file update) • Registration of user activity • Time stamp
BIM data handling (MMS)	<ul style="list-style-type: none"> • Support for BIM models in IFC format, in particular access to element data • Possibility of communication between project participants with regard to the model element 	<ul style="list-style-type: none"> • Support for BIM/3D models in native or open formats other than IFC indicated or established for the project • Support for BCF format • Time stamp

2.2.3 Analysis and conclusions

As can be seen in the table above (Table 1), the range of functionalities of project management tools is very wide. Creating a nationwide tool that meets the basic (also the most common) requirements in both areas of the CDE is certainly possible, but the scope of additional functionalities indicates a large variety of needs of individual procurers, which makes creating a universal tool an extremely complex task.

It should be noted that, as in the case of tools for creating, verifying and coordinating models, these functionalities are supported by the tools available on the market, and the free market mechanisms are the cause of their dynamic development.

Analysing the possibility of introducing a nationwide platform to run a project in terms of EDMS functionality, it is not without significance that maintaining servers allowing for safe storage of the expected amount of data requires launching a data center (only one typical large project involves even 190 organizations, 1 200 people and generates over 2.5 million documents [9]) and continuous supervision of the correct functioning of the tool. The nationwide platform also raises the need to train employees of the entire public sector in its operation and provide technical assistance, which generates significant costs.

Similar challenges are faced by the development of a nationwide tool to handle BIM data, in particular IFC models (due to typical requirements). However, the basic functionality - i.e. access to data contained in BIM models - is covered by commercial tools available on the market, most of which do not require the user to make any effort to purchase a license (freeware tools). In this context, **SPENDING PUBLIC FUNDS FOR THE CREATION OF A NATIONWIDE PROJECT MANAGEMENT TOOL IN THE BIM METHODOLOGY SEEMS UNJUSTIFIED.**

2.3 BIM platforms

Another group consists of platforms whose main objective is to broaden knowledge and provide access to BIM educational materials for the entire construction sector. Such platforms usually take the form of online knowledge bases, guidelines, dictionaries and good practice collections. Their important feature is also the sociological aspect aimed at building the involvement of the sector and the exchange of experiences between its participants.

This document pays special attention to platforms supported by state authorities as leaders influencing the development and dissemination of BIM.

2.3.1 International markets – selected European countries

NBS Toolkit (United Kingdom)

One of the most popular platforms of this type on the foreign market is the **NBS TOOLKIT**¹¹. It is a UK free platform supporting definition, management and verification of tasks and responsibilities of stakeholders at individual stages of the investment process.

It was created on the initiative of the BIM Task Group financed by the British government with the participation of BIM experts and organisations associating construction professionals and contractors (e.g. BIM Academy, Royal Institution of Chartered Surveyors (RICS)). The platform was created in order to help participants of the investment process to meet the BIM level 2 requirements¹².

The most important functionalities include the project design and the creation of a work plan on the platform together with: access to the IFC/RVT model viewer¹³, predefined tasks for each project phase according to BIM level 2 (easy definition of requirements adapted to the specific project phases), assignment of roles and responsibilities to the individual participants, defined and assigned Plain Language Questions (PLQ) to help make key decisions and prepare the EIR well¹⁴, guidelines for each investment phase explaining what it is, what documents are produced and who is responsible for what.

The platform provides support for a contractor in the design process in the form of NBS National BIM Library - a free library with BIM objects and other paid tools. It also provides data on UK building classification, model detail levels and standardized templates, in which manufacturers enter data on products supplied.

Another British platform is **DESIGNING BUILDINGS WIKI**¹⁵. This is an open, free knowledge base for spreading knowledge about BIM. The authors of the articles are, among others, Dr. Mark Bew and Mervyn Richards, responsible for defining and promoting BIM in the UK.

The main sections include information on key documents (EIR¹⁶, OIR¹⁷, AIR¹⁸, BEP¹⁹), standards (ISO, British Standard), BIM levels, or good cooperation practices.

In the Czech Republic, the Koncepte **BIM**²⁰ platform was established. It is a portal managed by the Czech Standardization Agency (Česká agentura pro standardizaci - ČAS), which was created in cooperation with the Ministry of Industry and Trade (Ministerstvo průmyslu a obchodu - MPO). Its main objective is to enable industry representatives to discuss and provide information to prepare the construction market for the mandatory use of BIM in public procurement planned in 2022.

¹¹ Source: <https://toolkit.thenbs.com/> [access: June 2020].

¹² Source: <https://bimdictionary.com/en/level-2-bim/1> [access: June 2020].

¹³ RVT - Revit project file. Currently (as of June 2020) the browser is in beta testing phase.

¹⁴ Exchange information requirements (BIM requirements) - an agreed source of digital information for a designed or existing resource (construction site), used to collect, manage and distribute the related information in a managed process.

¹⁵ Source: https://www.designingbuildings.co.uk/wiki/BIM_Wiki [access: June 2020].

¹⁶ See footnote 4.

¹⁷ OIR (Organizational information requirements)

¹⁸ AIR (Asset information requirements)

¹⁹ BEP (. Building information modelling execution plan)

²⁰ Source: <https://www.koncepcbim.cz/> [access: June 2020].

The platform provides information about ongoing and planned pilot projects, working groups and news and events. A separate section is devoted to the concept of BIM implementation in the Czech Republic. It contains the content of the Strategy²¹, key information related to it, implementation schedule and space for discussion²². The BIM concept also includes a reference to the BIM²³ (Czech-English dictionary) terminology database, which is a part of a wider project involving the development of terminology for technical standards.

In Scotland, the Scottish Futures Trust - an organisation set up by the Scottish government to ensure the profitability of public sector investment - operates the **BIMPORTAL PLATFORM**²⁴.

The portal provides guidance on the use of BIM for contracting authorities in Scotland and aims to support the public sector. It consists of the following modules:

- BIM Navigator - an online questionnaire that verifies which steps should be taken and implemented for a given project, thanks to the user's answers and key project data;
- Resources which include basic BIM definitions, templates of the most important documents, level 1 and 2 BIM standards, a collection of reports and studies, a video library presenting the basics of BIM, a collection of initiatives and educational training materials;
- Return on Investment Calculator - an interactive form designed to help a Contracting Authority decide on the implementation of BIM level 2 for the indicated investment.
- BIM case studies - a collection of information on completed investments with data on the project, scope of application of the BIM methodology, key benefits and conclusions ("lesson learnt" approach²⁵);
- Working Groups - a module containing information about the teams created to support the public sector by creating and coordinating the BIM implementation plan;
- Calendar of events.

BIMPORTAL²⁶ is an initiative of the Belgian Technical Committee BIM & ICT at the Scientific and Technical Centre for the Construction Sector. Its objective is to provide access to information and to offer opportunities to share it.

It consists of the following sections:

- News, Information about conferences and workshops organized;
- Files to download - templates of key documents and manuals with instructions such as Belgian BIM protocol, implementation plan, BIM classification system;
- Case studies - investments where BIM was used (Description of investment, project data, scope of BIM, applications);
- A database of documents (a collection of links to articles, guidelines, Belgian and foreign standards) and software (links to applications grouped by purpose) worthy of attention according to the authors.

²¹Koncepční zavádění metody BIM v České republice, 2017.

²² Source: <https://www.mpo.cz/cz/stavebnictvi-a-suroviny/bim/spusteni-portalu-koncepcie-bim--241042/> [Access: January 2020].

²³ Source: <https://www.nlfnorm.cz/terminologie-bim> [access: June 2020].

²⁴ Source: <https://bimportal.scottishfuturestrust.org.uk/> [access: June 2020].

²⁵ In a nutshell, it consists in the analysis of completed tasks, drawing conclusions from them and their implementation in subsequent tasks.

²⁶ Source: <https://www.bimportal.be/nl/contact/> [accessed June 2020].

The **BIM DICTIONARY**²⁷ is a collection of definitions and translations in several languages including English, Spanish, French, Arabic, Russian and Chinese. Since June 2020 it is also available in Polish. Among editors, reviewers and authors there are specialists from the UK, Australia, Portugal and representatives of language teams from individual countries. The dictionary is part of the BIMe **INITIATIVE**²⁸- a non-profit initiative aimed at improving the efficiency of the construction industry by facilitating the international exchange of knowledge and experience and developing free templates and tools to automate repetitive procedures.

OTHER

Apart from the platforms mentioned above, there are also blogs, magazines and other portals devoted to the BIM methodology, run by professionals or institutions connected with BIM. They owe their popularity to content written in a language that is accessible to beginners, frequent updating of data, the possibility to involve the reader in creating and commenting on the presented content, e.g. by providing commentary options.

2.3.2 Poland

No BIM platforms have been identified in Poland whose functions would be analogous to those of foreign organisations and whose operation or supervision would be performed by governmental organisations.

There are many blogs available on the domestic market, such as BIM corner²⁹, BIMblog³⁰, Crane in clouds³¹, but despite the high level of content offered, they have an educational function rather than a social impact (in terms of discussion forums or moderating working groups for specific industry initiatives).

2.3.3 Analysis and conclusions

As a result of the observations made on the foreign and Polish markets, there was a lack of platforms run by government institutions or public administration, whose main purpose would be education in BIM, setting the direction of BIM development, activation and motivation of construction market participants.

The UK and the Scandinavian countries, even though they are at a high level of BIM sophistication, have such tools which, on the one hand, through posted standards, good practices and other aids, have an educational function and, on the other hand, through the creation of a "meeting place" for industry representatives, have a social function.

On the Polish market, there is insufficient knowledge on the part of contracting entities to properly prepare the procedure. This approach is confirmed by the results of a survey carried out as part of the stages of the Project carried out so far, according to which systematizing the knowledge of the representatives of the construction industry and equalizing their competences are currently the most important challenges for the Polish construction sector.

The ever-increasing demand for BIM knowledge and the observed need to support contracting authorities and economic operators in developing and responding to the documentation of BIM proceedings are factors for which the creation of a central BIM platform in Poland should be considered.

A platform of this type would enable the sector to become more active, to consolidate its knowledge and to help it make strategic decisions on the use of BIM - **IT IS RECOMMENDED TO DEVELOP A TOOL OF THIS TYPE**. It should be noted that the state authorities that are the initiators of change will thus provide support to the sector and set the direction for BIM development in the country.

²⁷Source: <https://bimdictionary.com/> [access: June 2020].

²⁸Source: <https://bimexcellence.org/> [access: June 2020]

²⁹<https://bimcorner.com/pl/start/> [access: June 2020]

³⁰<https://www.bimblog.pl/> [access: June 2020]

³¹<https://www.craneinclouds.com/tech-bim/bim/> [access: June 2020]

2.4 Procurement platforms

A procurement platform in this study should be understood as one of the types of e-services, which is a business solution (commercial or custom-made for a specific customer) and another service of a technical and administrative nature, which enables the contract award procedure (i.e. procurement procedure, e-purchases) to be conducted electronically[5]. In this study, the terms "procurement platform" and "e-services" are used interchangeably and should be understood in the same way as defined above.

Many of the existing platforms also offer functionalities that go beyond the support of the e-Procurement procedure by creating comprehensive tools aimed at improving procurement efficiency - both cost and process. The tools presented in Figure 9. Although these functionalities are derived from a private market needs study, it can be predicted that they will also be incorporated into public market services.

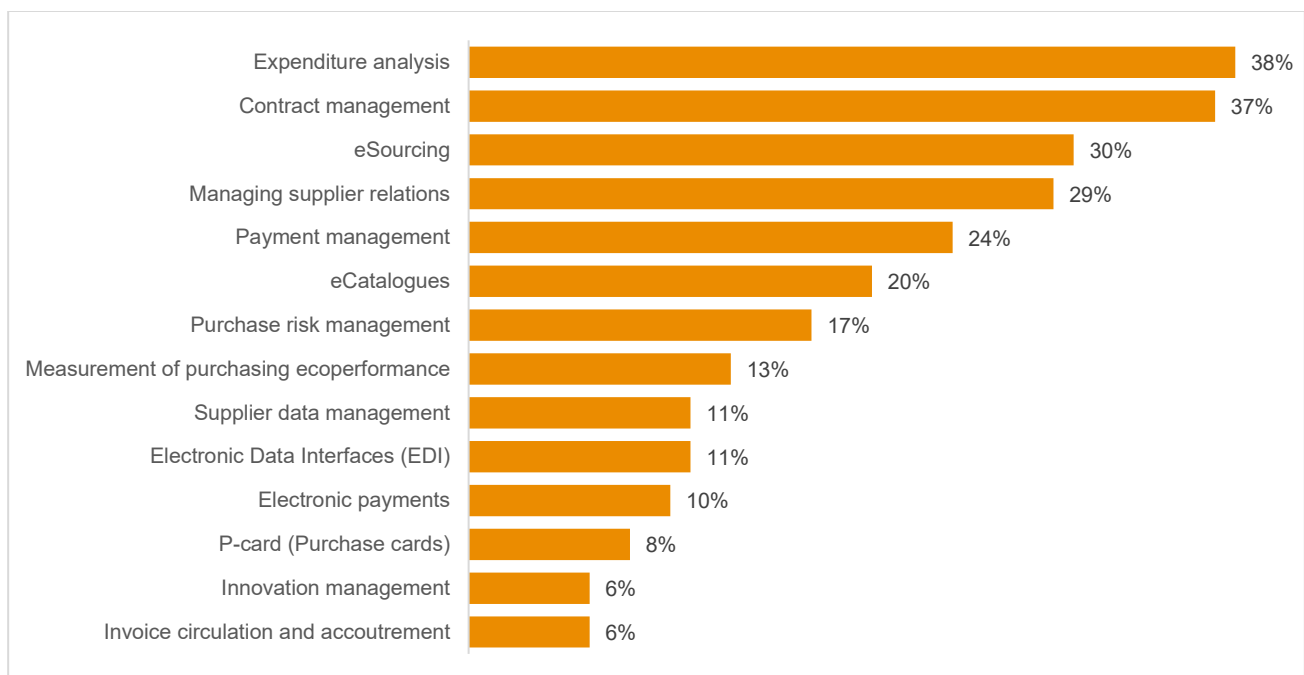


Figure 9. Priority functionalities of procurement systems based on a preference survey of 324 procurement directors from 33 countries
Source:[10]

However, the above functionalities will not be analysed in this document due to the lack of a direct link with the procurement procedure.

2.4.1 International markets - selected European countries

The functionalities of the procurement platforms are adapted to the procedures of the relevant markets. Outside the scope of European law, each country may implement them differently. Due to the need to adapt the proposed ICT solutions to the Public Procurement Law, resulting from the Project assumptions, this scope has not been analysed.

2.4.2 Poland

Pursuant to Article 61(1) of the Public Procurement Law (Journal of Laws 2019, item 1843), in a procedure for the award of a contract or a contest, communication between a Procurer and contractors is carried out using **ELECTRONIC MEANS OF COMMUNICATION**. This applies in particular to the submission of tenders, requests to participate in the procurement procedure or a contest, exchange of information and transmission of documents or statements between a Procurer and a contractor.

Due to the above-mentioned requirement and in relation to the advantages of e-Procurement, the Polish product market is already saturated with a multitude of tools with similar functionalities (there is a significant

fragmentation of the market in this respect). Additionally, in order to adjust the solution to their own needs, some entities are developing their own tools supporting the e-Procurement procedure. In relation to statutory requirements, they most often have functionalities, as shown in the Table 2.

Table 2. Functions of procurement platforms available to parties to the procedure

N.	The possibilities for a Procurer ¹	Opportunities of a Contractor ²
1	Creation and publication of a notice, including inclusion in the resources of the procedure documentation platform	Viewing the content of a notice
2	Update of the notice data with a time stamp of the changes made	Procedure documentation download (terms of reference and annexes),
3	Publication of additional documents from the course of procedure, e.g. answers to requests for clarifying the contents of the EMS submitted by the Economic Operators together with a time stamp of introduced changes	Requesting clarification of the contents of the Terms of Reference (sometimes requires creating an account and logging in)
4	Download of tenders submitted by the platform	Submission of a tender (requires an electronic signature, attaching scans of traditionally signed documents or other solutions)
5	Communication with contractors through the platform	Notification of changes to notices and of new notices for this type of search
6	Notice statistics, e.g. number of views, access to the history and activity of participants in an electronic auction	Communication with a Contracting Authority through the platform

In 2018, the Public Procurement Office developed A **MINIPORTAL**³² - a tool offered free of charge to ordering parties subject to the obligation of digitisation of public tenders (i.e. public tender parties who conduct tenders or contests whose value is equal to or exceeds the amounts specified in the PPL Act). The condition for using the miniPortal is:

- In the case of access to the section "For Contracting Authorities" - having a login and password for the Public Procurement Bulletin and the official address of the Electronic Inbox (*Pol. ESP*) of the institution to which Contractors will submit tenders;
- For the section "For Contractors" - creation of an individual account on the Electronic Platform for Public Administration Services (ePUAP).

The main objective of the tool is to support conducting the above-mentioned procedures with the use of electronic tools by enabling the use of the following functionalities:

- Preparation of a procedure form using an electronic form, which, depending on the selected tender options (e.g. mode), guides a user through the subsequent steps necessary to prepare a procedure form compliant with the requirements of the legislator;
- Publication of the procedure in the Public Procurement Bulletin;
- Encryption (in the section for Contractors) and decryption (in the section for Ordering Parties) of tenders by means of a key system;
- Communication between a Procurer and a Contractor through dedicated forms embedded in the miniPortal platform environment and the ESP [*Electronic Inbox*] of a Procurer;
- Submitting a tender with the necessary annexes, changing a tender or withdrawing it together with the appropriate forms completed from the miniPortal platform;
- Informing about activities on the portal (e.g. the fact of submitting a tender) via e-mail [11].

³² Source: <https://miniportal.uzp.gov.pl/> [access: June 2020].

2.4.3 Analysis and conclusions

As a result of consultations carried out under the Project, including with representatives of the Public Procurement Office, it should be noted that due to the fact that the private market is saturated with tools allowing for conducting purchase procedures and the existence of e-services offered free of charge by the Public Procurement Office (which covers the market demand) the **INTRODUCTION OF ANOTHER TOOL WITH IDENTICAL FUNCTIONALITIES IS NOT ECONOMICALLY JUSTIFIED**. However, it is worthwhile to trace whether the procurement procedure using BIM affects the range of desired functionalities of the procurement tools.

In order to be able to locate areas where it is potentially possible to incorporate BIM IT tools in order to improve the procurement procedure, the following diagram/scheme of its implementation is provided in line with applicable regulations. It should be noted that the procedure presented below is defined by the legislator in a very precise manner, Contracting Authorities are not able to accelerate the deadlines set out in the PPL. The use of BIM during the tender procedure does not significantly affect the course of these deadlines.

The first column of the table below indicates the most important steps of the procurement procedure in Poland. The second column indicates whether the implementation of individual tasks is currently carried out using procurement platforms (i.e. whether the indicated activities are carried out by the existing functionalities of these tools). The next column contains information on the impact of using BIM on the implementation of the identified steps of the procurement procedure. The last - fourth column contains the results of the analysis of needs and possibilities of using BIM tools (also going beyond the functionalities of procurement platforms).

Table 3. Procurement procedure - the most important steps in terms of public procurement law in the context of the possibility of using BIM and implementation of IT tools

Steps of the procurement procedure		Use of e-services (☒/☐)	References to BIM (if applicable)	Possibility of implementing IT solutions - analysis and conclusions (if applicable)
N.	[1]	[2]	[3]	[4]
1	Identification of the need for a procurement procedure.	<input type="checkbox"/>	-	<p>The results of the questionnaire carried out under the Project clearly indicate the need to support the BIM education process, especially among ordering parties, as more than half of the respondents representing this group have never participated in a project using BIM.</p> <p>These conclusions seem to be confirmed by the analysis of the content of the procurement procedures already published, during which one can see a duplication of requirements developed for other projects. The existence of this phenomenon may indicate a lack of ability of ordering parties to adapt requirements to the specificity of individual projects.</p> <p>CONCLUSION: THE PROPOSED SOLUTION SHOULD PROMOTE THE GROWTH OF THE KNOWLEDGE AND COMPETENCE OF THE INDUSTRY AND ALLOW ITS FREE MOVEMENT. IT SHOULD BE NOTED THAT NONE OF THE PLATFORMS EXISTING ON THE MARKET COMBINES THE FUNCTIONALITY THAT INCREASES THE LEVEL OF KNOWLEDGE OF THE CONSTRUCTION SECTOR WITH THE PROCUREMENT PLATFORM - DUE TO THEIR DIFFERENT PURPOSE THEY ARE SEPARATE TOOLS AND IT DOES NOT SEEM REASONABLE TO COMBINE THEM.</p>
2	Preparation of the documentation of the procedure, among others:	<input type="checkbox"/>	-	-
2A	• Description of the subject of the tender (Pol. OPZ);	<input type="checkbox"/>	<p>³³BIM requirements are a direct equivalent of the description of the subject of the tender in terms of BIM requirements.</p> <p>The BIM model may be an annex to the procedure file, it functions the same way and is subject to the same provisions as the other annexes.</p>	<p>Note 1: The preparation of BIM documents, in particular the EIR, is the primary responsibility of a Procurer, which plans to implement an investment using the BIM. In order to properly prepare the terms of reference, a certain level of knowledge is necessary:</p> <ul style="list-style-type: none"> • Prepare requirements, • Verify during the project how they are implemented, • Verify the final products of the implemented investment task.

³³English language literature uses the term of Employer Information Requirements (EIR), ISO 19650 introduced the term Exchange Information Requirements (EIR).

Steps of the procurement procedure	Use of e-services (☒/☐)	References to BIM (if applicable)	Possibility of implementing IT solutions - analysis and conclusions (if applicable)
N.	[1]	[2]	[3]
			<p>Tools used in other countries such as "BIM platforms" support procurers in the preparation of BIM documents by offering guides or electronic tools in their resources that support making key decisions for the project.</p> <p>CONCLUSION 1: SIMILARLY TO THE COMMENTS ON STEP 1, THE TOOL SHOULD ALLOW FOR INCREASING THE KNOWLEDGE OF THE USERS, AND IT IS RECOMMENDED TO DEVELOP INTERACTIVE TOOLS TO FACILITATE DECISION MAKING OR THE DEVELOPMENT OF BIM DOCUMENTS.</p> <p>Note 2: In the case of a project executed using BIM, when a public procurer in Poland is obliged to make the design documentation (i.e. in the case of a tender for construction works) available together with the tender documentation, the BIM model reflecting the design assumptions presented in the documentation should also be available. It should always be provided in an open form in order to maintain the principle of competitiveness (i.e. it should be possible to view its content using commonly available, free tools)³⁴. The key in terms documentation to be supplied. Making available a BIM model meeting the relevant quality standards, i.e. developed by an entity representing a high level of BIM maturity,³⁵ may result in a more efficient procurement procedure (reduce the number of requests for clarification of the content of the Terms of Reference relating to the BIM data provided). Moreover, BIM technical documentation meeting the relevant established criteria will allow Contractors to analyse it more efficiently.</p> <p>CONCLUSION 2: THERE IS CURRENTLY NO NEED TO IMPLEMENT ADDITIONAL TOOLS DEDICATED TO BIM MODELS IN THE PROCUREMENT PLATFORM. THESE ARGUMENTS CONFIRM THE NEED FOR EDUCATION NOT ONLY AMONG THE PROCURERS BUT</p>

³⁴At the same time, it is worth quoting buildingSMART Poland's position on electronic modelling tools, according to which the term "generally available tools" means those offered by numerous market players and available to an unlimited number of users. In addition, buildingSMART points out that in the current situation, in the practice of public procurement, there is hardly any situation in which procurers require tenders to be drawn up using BIM models, and at present this issue does not seem relevant. Source: [16]

³⁵ "Maturity" is defined as the degree to which a specific process (i.e. a set of consecutive and causally related changes) is defined, controlled, coherent and effective in relation to the expected results of its implementation. Source: [19]

Steps of the procurement procedure		Use of e-services (☒/☐)	References to BIM (if applicable)	Possibility of implementing IT solutions - analysis and conclusions (if applicable)
N.	[1]	[2]	[3]	[4]
ALSO AMONG THE CONTRACTORS.				
2B •	Terms of Reference (ToF) / description of needs and requirements	<input type="checkbox"/>	These elements are part of the ³⁶ BIM requirements - this information should be included in the ToF/description of needs and requirements	-
2C •	Model contract.	<input type="checkbox"/>	The relevant BIM Annex, called the BIM Protocol, may be attached to the model contract ³⁷ .	-
3	Publication of a tender notice	<input checked="" type="checkbox"/>	-	-
4	Conduct of the procurement procedure	<input checked="" type="checkbox"/>	-	-
5	Opening of tenders	<input checked="" type="checkbox"/>	-	-
6	Evaluation of tenders, which mainly concerns the following conditions:	<input type="checkbox"/>	-	-
6A •	Formal correctness of submitted tenders;	<input type="checkbox"/>	-	-
6B •	Conditions of tender procedure participation;	<input type="checkbox"/>	These conditions often make additional references to BIM, in particular concerning the technical or professional capacity of economic operators, and in particular the possession of appropriate knowledge and experience and the availability of persons capable of performing the contract for which the required level of BIM qualification or experience is specified.	-
6C •	Criteria for the evaluation of tenders.	<input type="checkbox"/>	These criteria relate to the quality of a tender, technical parameters, functionality or other characteristics. In this respect, reference may be made to criteria already in use, such as <ul style="list-style-type: none"> • Preparation of documentation using BIM (contractor's declaration) - currently this criterion is not used; 	If electronic test forms are used, they can be evaluated automatically by electronic tools. However, due to the unresolved position of the indicated criterion (one-time use in 6-year practice of using BIM in public procurement), no solutions are currently recommended in this respect.

³⁶ See also footnote 33.

³⁷ The original reference in PN-EN ISO 19650 is "project information protocol". It is a set of rules governing legal aspects of information exchange.

Steps of the procurement procedure		Use of e-services (☒/☐)	References to BIM (if applicable)	Possibility of implementing IT solutions - analysis and conclusions (if applicable)
N.	[1]	[2]	[3]	[4]
			<ul style="list-style-type: none"> Preparation of methodology for the execution of the tender³⁸ (this can be referred directly to the contents of the BIM Tender Plan³⁹); Submit additional studies to confirm that a contractor has the level of knowledge, skills and understanding of the BIM⁴⁰ intentions expected by a procurer; Competence test of BIM staff dedicated to order execution (coordinator and manager)⁴¹. 	
7	Drawing up a protocol on the activities carried out.	<input type="checkbox"/>	-	-
8	Awarding of a public procurement contract to a Contractor who fulfilled the conditions for participation in the procedure and obtained the highest tender score according to the accepted tender evaluation criteria, which is crowned by signing the contract.	<input type="checkbox"/>	-	-

From the above analysis it can be concluded that the **CURRENT PROCUREMENT TOOLS AND THE PROCEDURE ITSELF DO NOT REQUIRE ANY ADDITIONAL FUNCTIONALITY DUE TO THE USE OF BIM**. It is not excluded that with the development of BIM in Poland and as a result of administrative and legal changes, e.g. with the establishment of the MacroBIM formula⁴², this situation will change, i.e. it will be reasonable to develop additional IT tools supporting procurement procedures. Currently, the biggest challenge for the construction industry is to prepare appropriate tender documents for BIM, to which a tool of the "BIM platform" type may be recommended for implementation. (see section 2.3.3).

³⁸ E.g. within the scope of the investment "Construction of the Cross-Country Skiing and Biathlon Centre in Szklarska Poreba - Jakuszyce". (the first procedure included the selection of a designer and a project manager, the second - a general contractor).

³⁹ The Pre-appointment BEP (BIM Execution Plan) – is a document drawn up by a contractor in response to BIM requirements (see footnote 14). It describes the method of tender execution planned by a contractor.

⁴⁰ E.g. within the framework of the investment entitled "Construction of the Wielkopolska Children's Health Centre (Pediatric Hospital) and its equipment.

⁴¹ This procedure was introduced under the procedure carried out by GDDKiA under the procedure "Development of design documentation and accompanying studies for the task entitled: "Construction of the Zator bypass in the course of national road No. 28" together with obtaining administrative decisions and exercising author's supervision.

⁴² The MacroBIM phase is an element of an assets purchase process, which includes the delivery of the program concept (design and execution) with the proposed indicative total cost of execution of a given investment - the Target Cost, which should be the starting point of each investment carried out in the BIM methodology and the basic economic criterion of the project. From the possible base of design solutions for the pre-design (conceptual) phase only those that remain after two criteria have been imposed on their combination: the minimum quality of the design solution and the maximum Target Cost assumed in the process of concept evaluation are selected and evaluated. Evaluation of the concept assumes indicative calculations for m2 of gross/net function, m3 of cubature, unit calculations, other possible to obtain from solid models (without any definition of building partitions or openings) and the combination of groups of functions (without division into individual use of rooms).

2.5 Tools for publication and analysis of procurement procedure

This group of tools discusses those IT solutions that do not allow for direct procurement procedure, but use information related to their proceeding, in particular "notice boards" that allow for searching for tenders and present basic information about them.

2.5.1 Foreign market – selected European countries

A commonly associated tool representing the tool group described above is **TENDERS ELECTRONIC DAILY (TED)**⁴³. It is an electronic database providing access to current and archived European public procurement notices above certain value thresholds. These are defined according to the type of tender⁴⁴.

As with tenders required to be published by the Directive, a number of local public sector notice databases have also been set up, including in Scotland⁴⁵, Wales⁴⁶ with access to tenders from all over the UK and Northern Ireland⁴⁷, the Czech Republic⁴⁸ and Spain⁴⁹.

2.5.2 Polish market

In response to the obligation to digitise the public procurement procedure introduced in the PPL [*The Act*], resulting directly from the implementation of EP and Council Directives 2014/24/EU and 2014/25/EU, as well as due to the fragmentation of the e-services market, which results in the dispersion of information about the procedures, the Public Procurement Office prepared a project called **E-PROCUREMENT**. Currently, works related to the development and launch of the platform are in progress and their completion is planned for 15 July 2022.[12].

The project assumes the development and implementation of a platform that will ensure completeness and consistency of information on the functioning of the public procurement market in Poland. The platform is to be a kind of central data repository collecting information from e-services portals. The functionalities built within the platform will also facilitate and shorten the course of activities undertaken within the scope of the public procurement procedure. The concept diagram of the platform is presented in Figure 10.

⁴³ Link to the portal: <https://ted.europa.eu/TED/browse/browseByMap.do> [access: June 2020].

⁴⁴ These thresholds are: 5 350 000 € for works contracts and concessions for works or services, 139 000 € for design contests and 428 000 € for supplies and services, among others [17]. All threshold values are also specified in currencies other than the euro, including the Polish zloty.

From January 2020, the exchange rate of the euro in relation to the Polish zloty will be 4.2693. Source:

<https://www.portalzp.pl/nawosci/od-1-stycznia-2020-r.-nowe-progi-uniijne-i-kurs-euro-w-zamowieniach-publicznych-17577.html> [access: June 2020].

⁴⁵ Link: https://www.publiccontractsscotland.gov.uk/search/search_mainpage.aspx [Access: June 2020]

⁴⁶ Link: <https://www.sell2wales.gov.wales/> [Access: June 2020]

⁴⁷ Link: <https://etendersni.gov.uk/epps/prepareAdvancedSearch.do?type=cft> [Access: June 2020]

⁴⁸ Link: <https://opentender.eu/cz/search/tender> [Access: June 2020]

⁴⁹ Link: <https://opentender.eu/es/search/tender> [Accessed June 2020]

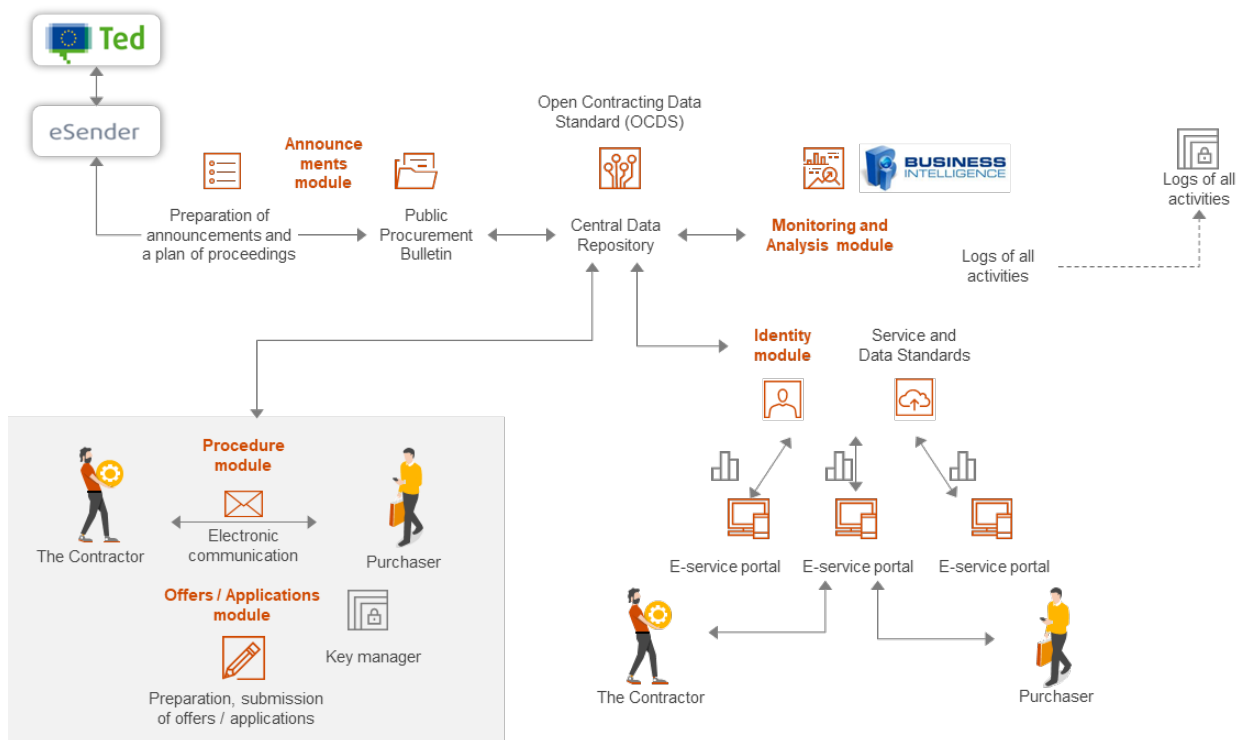


Figure 10: The e-Procurement platform concept
Source: Own study based on [13]

The centre of the e-Procurement platform is a module of the *Central Data Repository* (hereinafter: CDR), which is to be a place to store structured data, metadata and unstructured information from the entire life cycle of the tender, both national and EU. The module is also to provide relevant information to the Notice Module, through which tender procedures will be published in the Public Procurement Bulletin.

The *Monitoring and Analysis Module*, using data collected in the CDR, is to enable automation of selected activities undertaken in the course of the procurement procedure, to improve the fulfilment of reporting obligations by a Procurer resulting from executive regulations to the PPL [The Act] and to enable current tracking of information about the procedures.

The e-Procurement platform is also intended to enable procurement procedures to be conducted. The *Procurement Procedures and Tenders/Requests Module* are to be used for this purpose. Until this range of functionalities is launched, they may be implemented by the existing e-services, which will be connected to the e-Procurement platform using a publicly available API⁵⁰.

2.5.3 Analysis and conclusions

The objective of the e-Procurement Project is to ensure an effective, unified, meeting the needs and expectations of stakeholders in the digitised public procurement procedure in Poland. This objective is the same as that indicated in this Project. It is worth noting that both initiatives – the implementation of BIM as well as the e-Procurement platform - although different, have at least several common features:

- They are based on the intensification of digitisation activities;
- They are aimed at improving the effectiveness of the tasks performed,

⁵⁰ API - Application Programming Interface - a set of rules describing how programs or subprograms communicate with each other.

- They are designed to serve stakeholders – both contracting authorities and contractors - by increasing access to and monitoring of information⁵¹.

In the light of the current top-down activities aimed at implementing BIM and the fact that they are reflected in the conducted procedures, it is concluded that **THERE IS A JUSTIFIED NEED TO COLLECT DATA THAT WILL ALLOW TO MONITOR THE EFFECTS OF ACTIVITIES CARRIED OUT TO IMPLEMENT BIM IN POLAND** or to study the development of already observed trends. Due to the potential possibilities of e-Procurement, the use of these data should be considered. Obtaining information on tenders from BIM would allow, among others:

- Obtain reliable, comprehensive data on the progress and effects of activities carried out to implement BIM in public investment;
- Examine and verify the application of the requirement to use BIM and other top-down BIM requirements that may translate into data contained in procedures and collected by e-Procurement;
- Combine the results of analyses carried out for the public market with the results of private market analyses (data on private investments can be obtained e.g. using questionnaires).

THE PUBLICATION OF SUCH DATA MAY BE AN ADDITIONAL IMPULSE TO INTENSIFY ACTIVITIES AIMED AT IMPLEMENTING BIM IN POLAND.

Since this Project has developed a document describing the recommended direction of BIM-related changes in the construction industry, it is worth quoting a few of the theses and proposals for action indicated in it. Below (Table 4) the related data collected by the e-Procurement platform are presented and the potential benefits of analysing them in terms of BIM are indicated.

Table 4. Potential benefits of analysing data on public procurement procedures in terms of applying BIM

N.	Theses and assumptions of the Road Map developed under the Project	Type of data collected under e-Procurement (examples)	Potential benefit for stakeholders
1	"(...) the nature of (PAS 91) favours early control over the investment process. Given the nature of the MacroBIM phase, this would be the first opportunity for a procurer to assess the organisational suitability of tenders in a procurement procedure'.	Conditions for participation (if specified by a procurer) or selection criteria	Monitoring of desired characteristics of the BIM-based procurement entities and the possibility of adapting top-down actions to these expectations
2.1	Integration of the MacroBIM phase into a procurement procedure ⁵²	<ul style="list-style-type: none"> • Estimated value of the object of a tender 	<ul style="list-style-type: none"> • Data on the costs of a given type of work can help to create and subsequently update indicators for the valuation of design works with the use of BIM
2.2	"In order to increase interest in the procurement procedure, as in the case of a design contest, procurers should provide for the reimbursement of the costs of participation in the procedure for contractors who have been invited to submit tenders".	<ul style="list-style-type: none"> • The value of the target cost (i.e. the amount of the most advantageous tender in the traditional - not including the MacroBIM phase – procurement procedure) 	<ul style="list-style-type: none"> • Monitoring the level of remuneration as part of the conceptual work of multi-discipline project teams
2.3	"Financial incentive factors of integrated contracts will partly eliminate these disproportions, also in the case of profits for contractors (concerning remuneration of designers in Poland and developed countries)	<ul style="list-style-type: none"> • The amount of reimbursement of costs of participation in the procedure (if a procurer provides for their reimbursement) 	
2.4	BIM can optimise costs, especially in terms of project life cycle costs		
3	"Establishment of contract templates or a model contract for an investment dealt with using BIM".	Amendments to contracts using BIM (for BIM) and their justification	Control over the functioning of the BIM provisions used in construction contracts

⁵¹ Source: <https://www.uzp.gov.pl/e-zamowienia2/informacje> [access: June 2020].

⁵² Definition and assumptions are briefly discussed in footnote **Error! Bookmark not defined.**

N.	Theses and assumptions of the Road Map developed under the Project	Type of data collected under e-Procurement (examples)	Potential benefit for stakeholders
4	"It is recommended that procurers be obliged to use non-price criteria for the evaluation of BIM-related tenders with a minimum weighting of 20%".	Criteria for evaluation of tenders other than price, weighting of those criteria	Development of benchmarks for evaluation criteria of tenders other than the price related to BIM and their publication in the PPO [<i>Public Procurement Office</i>] resources
5	"Green procurement" places great emphasis on the entire life cycle of a product, service or work, and not just the cost of purchasing it. Such an action, in turn, affects more economical and effective spending of public funds by the entities which have them at their disposal, which is consistent with the principles contained in the Public Finance Act".	Green procurements	Monitoring the market for the environmental impact of construction projects is one of the most important international issues and is important in the context of life cycle analysis of construction works, to which BIM is also applied
6	"Recommended updates of the roadmap plan for Poland may make time corrections for the maturity of individual matrix nodes".	Number, values and CPV codes of contracts executed with BIM	<ul style="list-style-type: none"> Monitoring the scope of the market using BIM in specific price thresholds (progress analysis of the implementation process) Monitoring the scope of the market using BIM in specific price thresholds and business areas Identification of new areas of construction activities implementing BIM and preparation of model documents dedicated to these types of services/works Monitoring the public market situation in terms of the planned financial and organisational needs of BIM

In order to use the procurement data collected on the e-Procurement platform, it is necessary to develop a technical infrastructure that will allow access to the relevant information. To this end, two methods of connection have now been identified and analysed (Table 5).

Table 5. Analysis of how to connect to the e-Procurement platform in order to use data collected in the CDR

N.	Method	Disadvantages/risk	Advantages/opportunities
1	Including BIM-related issues in the forms to be completed by procurement entities using eServices	<ul style="list-style-type: none"> Requires modifications to the forms to be handled It may require the extension of the e-Procurement technical infrastructure (e.g. in terms of server capacity due to the increased amount of data handled) Dependence on political will to modify e-Procurement 	<ul style="list-style-type: none"> BIM data could be included in the procurement information published by the PPO

N.	Method	Disadvantages/risk	Advantages/opportunities
2	Development of a separate tool connected with ⁵³ e-Procurement through the API platform made available by the contractor (similar to the connection with commercial e-services available on the market)	<ul style="list-style-type: none"> • API⁵³ made available by the e-Procurement contractor may not provide for the possibility of developing a tool that would acquire the scope of e-Procurement data required to perform the analyses planned for BIM. 	<ul style="list-style-type: none"> • Allows independent modification of the functionality of the BIM analysis tool in terms of e-Procurement • Possibility to shape the form and scope of the reports to be created

Due to the more favourable disadvantage/benefit/risk ratio for the second method, its use is recommended. However, due to the fact that API⁵³ of the e-Procurement platform is not yet developed (work on this solution is in progress), it is not possible to draw up detailed guidelines on how to obtain data from the e-Procurement platform and the description of functionalities related to the analyses planned to be performed on their use will be presented in a general way.

⁵³ The concept is explained in footnote 50, page 29.

3

Concept of the proposed IT system



3 Concept of the proposed IT system

3.1 Objectives of the IT systems creation

The voices of representatives of the construction market in Poland raised during the consultations carried out under this Project - during meetings with stakeholders and in the questionnaire - clearly indicate the need for BIM education. The main objective of the IT system planned to be launched (hereinafter referred to as the "BIM Platform" or "Platform") is to respond to this need.

The BIM platform is supposed to be a place that presents the most up-to-date information about top-down actions taken to promote BIM in Poland and their effects.

Additionally, as part of the functionality of the BIM Platform, it is planned to launch interactive tools that will directly support BIM-related activities and processes undertaken by Project stakeholders as part of investment projects.

It should be noted that the IT infrastructure is only a tool for activities aimed at dissemination of BIM in Poland. Therefore, the concept of the BIM Platform presented in the following chapters may be subject to change - **IT IS NECESSARY TO ANALYSE THE POSSIBILITIES OF ITS DEVELOPMENT WITHIN THE PROPOSED SOLUTIONS ON AN ONGOING BASIS (AT LEAST OVER A 2-YEAR CYCLE) AND TO FOLLOW NEW PATHS OF TECHNOLOGY DEVELOPMENT IN ORDER TO SEARCH FOR THE BEST SOLUTIONS THAT FIT INTO THE IDEA OF THE BIM PLATFORM.** It should be kept in mind that technology development is faster than in other areas. The biggest challenge may be to adapt the market to legal changes and to adapt people to new working methods accompanying BIM.

3.2 Basic assumptions and functional features

The creation of a "BIM Platform" meeting the above-mentioned objectives is a complex task, the implementation of which **SHOULD BE CARRIED OUT IN STAGES AND IN A MANNER COORDINATED WITH OTHER ACTIVITIES UNDERTAKEN TO IMPLEMENT BIM IN POLAND.** Therefore, it is recommended that individual functionalities should form separate modules, whose development and implementation will be time correlated with the development of BIM and digitization of the construction industry in order to create an optimal environment for the ongoing changes.

For a designed BIM Platform to fulfil its dedicated tasks it must have at least the following features:

- **MODULARITY** – the platform should be able to be modified and expanded in response to market needs, in particular those signalled by stakeholders and users of the Platform;
- **FLEXIBILITY** – legislative, organizational, etc. changes should be easily adapted to the content and functionality of the Platform;
- **OPENNESS** – to enable the platform to be extended with further modules, it is recommended to base its operation on open programming languages;
- **SIMPLICITY AND INTUITIVENESS** – the Platform users will have different levels of skills, experience and knowledge of BIM. Therefore, it is important to ensure simple interfaces and accessibility in terms of content presentation;
- **COMPLIANCE WITH THE ADOPTED BIM DEVELOPMENT PATH IN POLAND** – once the assumptions of the BIM roadmap for Poland have been approved, all documents published on the Platform should be compliant with it. It is also necessary to update and develop the content of the Platform so that it presents the fullest possible state of knowledge in each period of its operation;
- **MARKET NEUTRALITY** – due to the public nature of the platform, it is necessary to maintain the objectivity of the information contained therein and not to invoke trademarks.

3.3 Basic technical assumptions

The most important technical assumptions that enable the proper operation of the Platform are:

- Correct and uniform display in all popular web browsers and in particular: Microsoft Edge, Firefox, Chrome, Safari, Opera (in the latest versions as of the date of contract);
- RWD (Responsive Web Design) user interface compatibility;
- The platform must be suitable for access by visually impaired persons, i.e. compliance with WCAG 2.1 requirements at AA level;
- The platform should have access control to selected content by logging in with a login and password;
- The security features of the information must be implemented in such a way as to prevent its unauthorised disclosure, modification, deletion or destruction;
- All configuration files related to application security must be stored in places protected from unauthorized access;
- The structure of the platform must allow for the introduction of additional language versions of the portal and the expansion of the platform with additional modules;
- Access to the Platform and all module functionalities is to be possible for users using only computer hardware connected to the Internet without the need to install a dedicated desktop software component, including mobile devices based on Android and iOS systems.

3.4 BIM Platform Modules

Below is a list of the modules that are planned to be implemented within the BIM Platform. Due to organizational and technological capabilities of the Beneficiary, it is recommended to spread the process of its creation over time.

For each of the proposed modules the following have been presented:

- Objective – Indication of the effects that are planned to be achieved by implementing the module;
- For whom? – Identification of the main stakeholder groups for which the module is dedicated;
- Access – information on the level of access to the modules (data available to everyone, data available after logging in – resources or functionalities available to users with an account on the Platform);
- Content/functionality assumptions – a short description indicating how each module should work to achieve the objectives indicated in the first section of the description;
- Other conditions/characteristics specific to each module.

3.4.1 "BIM documents"

The module is to constitute a knowledge base for stakeholders, which will contain the documents approved by the Beneficiary and the results of bottom-up initiatives. This will ensure full access to all studies on BIM.

Objective	Develop a publicly available database of documents and studies on BIM developed as part of the implementation of bottom-up and top-down initiatives, which will support representatives of the construction market in Poland in the implementation of investments using BIM
For whom?	All stakeholders in the construction industry
Access	Public resources

Assumptions about content/functionality	<ul style="list-style-type: none"> • Develop a structured document repository that can be downloaded from the resources of the BIM Platform in PDF or editable format, e.g. DOCX and search, sort and view documents • If other BIM documents are developed as part of activities related to the implementation of BIM in Poland - their current publication within the module resources
Resources	<ul style="list-style-type: none"> • Deliverables implemented and approved under this Project • BIM standards adopted in Poland • Good practice manuals, templates of documents developed as part of bottom-up and top-down activities undertaken to implement BIM in Poland • Reports on the results of questionnaires examining the state of BIM implementation in Poland, carried out according to the assumptions indicated in the description of the "Questionnaires" module (point 3.4.8) • Using project-dedicated documents as a basis for developing interactive templates for BIM documents (e.g. Exchange Information Requirements, BIM Execution Plan), containing user guidance through the process of preparing a document

3.4.2 "BIM requirements"

Objective	Develop a guide for procurers planning to conduct a BIM procedure, which will enable them to formulate BIM requirements based on the BIM documents available in the resources of the Platform
For whom?	Public and private sector Contracting Authorities
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • The Guide for Contracting Authorities should be developed based on a guide for the Exchange Information Requirements template, developed and approved as part of this Project • It should have references to the content of other documents stored on the BIM Platform resources (indication of additional sources addressing the issues necessary for the proper preparation of Exchange Information Requirements)

3.4.3 "BIM Lexicon"

Due to the non-uniform BIM nomenclature used in the Polish context, it is recommended to prepare and publish a meaningful and coherent dictionary. As part of the development of BIM, it should be expanded and (if necessary) modified.

Objective	Develop a publicly available database of BIM terms together with their description, develop means of communication between market representatives with regard to the BIM nomenclature used in Poland
For whom?	All stakeholders in the construction industry
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • Creation of a publicly available BIM dictionary containing: a list of terms, their definitions and discussion of related issues • Search for terms • Allowing market representatives to propose amendments to terms, definitions and discussions • Update the lexicon if, as part of the activities related to the implementation of BIM in Poland, documents affecting changes in the content of this module will be developed
Resources	<ul style="list-style-type: none"> • Deliverables approved under this Project • BIM standards adopted in Poland

3.4.4 "Public Consultation"

Due to the fact that there are many grassroots initiatives in Poland that carry out work related to the development of various types of BIM documents, it is advisable to create a medium that will allow the results of their work to be published and consulted as widely as possible. This conclusion was confirmed by the stakeholders present at the meetings that took place in one of the previous stages of this Project. Additionally, within the module it will be possible to consult with representatives of the market of documents developed by relevant expert working groups acting on behalf of the Beneficiary (as recommended in the document developed during the previous stage of work).

Objective	Create a forum for the exchange of opinions of representatives of the construction market in relation to the results of work related to the creation of documents supporting the process of BIM implementation in Poland - stimulating the market by encouraging cooperation, creating a community working to standardize BIM in Poland
For whom?	All stakeholders in the construction industry
Access	Public resources / Resources or functionalities requiring login
Assumptions about content/functionality	<ul style="list-style-type: none"> Platform users can submit a document for the consultation process The documents provided to Beneficiary through the Platform, after obtaining a positive decision of Beneficiary, will be able to be sent for consultation through publication in the resources of the Platform. The possibility of submitting comments on a document via the electronic form on the website Publication of consultation reports and studies consulted and approved by the Beneficiary in the "BIM Documents" resources
Resources	<ul style="list-style-type: none"> Input: documents provided by originators/initiators of specific projects for stakeholder consultation Output: documents approved by the Beneficiary together with reports documenting a consultation process

3.4.5 "Working groups"

It should be assumed that work on the implementation of BIM in Poland will be carried out in a multi-faceted manner, by units established for this purpose or within existing structures. Informing the market about the activities of these groups will allow to prepare for the planned changes.

The implementation of the module depends on the Beneficiary's decision to establish working groups.

Objective	Provide broad access to information on the operation of the units established by a Procurer (or operating within the existing structures) to prepare for BIM implementation in Poland.
For whom?	All stakeholders in the construction industry
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> Guide to the structure of teams appointed by a Beneficiary to carry out tasks resulting from the roadmap Sections dedicated to working groups will contain detailed information about the principles of operation, composition, planned tasks, planned and achieved results (e.g. on developed consultation documents and approved documents).
Basis for operation	<ul style="list-style-type: none"> Assumptions of the roadmap developed and approved under this Project The assumptions of other BIM strategy documents

3.4.6 "Video"

The video section will allow to convey basic information about BIM in an accessible, visualised way. Additionally, its advantage is the ease of interest in the presented content of younger users, which increases the possibility of reaching school students, which is in line with the conclusion of the questionnaire conducted under this Project (77% of the respondents admitted that there is a need to educate BIM already for secondary school students). These documents will be able to be used as learning aids for schools, universities or market representatives as part of self-education.

Objective	Support for the construction sector in acquiring knowledge about BIM using a form that is accessible to users, stimulating the market, encouraging the search for knowledge, analysing market preferences and demand for documents presenting BIM issues
For whom?	All stakeholders in the construction industry, secondary school students, students of architecture, construction, environmental engineering, etc. (1st degree studies)
Access	Public resources
Functional assumptions for the module	<ul style="list-style-type: none"> • Possibility to play videos presenting BIM issues directly on the Platform • Creation of a system for evaluating materials/documents in order to monitor market interest and match the content on the Platform to its expectations
Resources	<ul style="list-style-type: none"> • Short films (up to 3-5 minutes) made mainly in animation technique, with a narrator and subtitles in Polish and English

3.4.7 "E-learning"

The need for education has been repeatedly identified during stakeholder consultations. Short forms allowing for independent exploration of BIM issues will allow to broaden the knowledge of Platform users at a time chosen by them.

Objective	Support for representatives of the construction sector in acquiring knowledge about BIM, stimulating the market to acquire knowledge about BIM in specific thematic areas
For whom?	All stakeholders in the construction industry, secondary school students, students of architecture, construction, environmental engineering, etc. (1st degree studies)
Access	Resources or functionalities requiring login
Functional assumptions for the module	<ul style="list-style-type: none"> • Enabling the users of the Platform to complete online learning courses divided into short thematic packages
Resources	<ul style="list-style-type: none"> • Learning courses that address BIM at different levels of user experience

3.4.8 "Surveys"

In order to analyse the level of implementation and maturity of BIM of the construction market representatives, it is necessary to constantly monitor it. Using the same questions will allow to compare the obtained values and to forecast the pace of implementation.

Objective	Develop a tool for cyclical market maturity testing of BIM using the CAWI method ⁵⁴ .
For whom?	All stakeholders in the construction industry
Access	Public resources

⁵⁴ Computer Assisted Web Interview - a method of collecting information using a web-based questionnaire form.

Assumptions about content/functionality	<ul style="list-style-type: none"> • The possibility of carrying out questionnaires on the use of BIM to assess the level of implementation of the methodology on the market • A tool enabling: collection of questionnaire results and their analysis, generation of reports • Ability to save a user to the contact list (mailing list) to be notified when a questionnaire is launched
Input data	<ul style="list-style-type: none"> • Questionnaire carried out under this Project

3.4.9 "BIM Objectives"

Adapting the requirements to real needs and possibilities is one of the conditions necessary to properly draw up the BIM documents necessary for the project. The module should prepare Contracting Authorities for this task.

Objective	Supporting investors in investment planning by recognizing their expectations and helping them to define their assumptions, MAKING THE REQUIREMENTS OF INVESTORS' REQUESTS FOR TENDER AND THE BIM METHODOLOGY REALISTIC.
For whom?	Procurers, other entities defining BIM requirements
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • Enabling users to select optimal methods of achieving the assumed BIM objectives during project implementation • The basis for making recommendations will be the information provided by a user in the scope of owned or planned resources through an appropriate form.
Input data	Developments implemented and approved under this Project, in particular the Roadmap

3.4.10 "BIM Navigator"

Due to the different level of maturity of BIM of public entities and the lack of guidelines on actions that should be taken to prepare an entity to deliver a project with the use of BIM, it is recommended to develop a tool that will indicate these actions or facilitate taking decisions that are crucial for the success of the implementation process.

Objective	Creating a tool for public entities to self-assess the maturity of the BIM and to obtain recommendations on the next steps they need to take to implement and use the BIM effectively
For whom?	Public contracting authorities
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • Present in the form of a radar diagram of the characteristics of an entity in terms of basic resources and key issues for the success of BIM implementation • Define the BIM maturity level based on the self-diagnosis form • Presentation of conclusions and recommendations on further actions

3.4.11 "Return on investment calculator"

An interactive tool allowing for quick verification of savings achieved as a result of the implementation and use of BIM within a project. The calculator informs about the savings resulting from the optimization of the investment planning process, implementation at the stage of design, construction and operation of a facility, while taking into account the expenses incurred for the implementation of BIM (e.g. the cost of purchasing CDE or training).

Objective	Assistance in identifying the benefits and savings of implementing the BIM for investment
For whom?	Public and private procurers
Access	Public resources / Resources or functionalities requiring login
Assumptions about content/functionality	<ul style="list-style-type: none"> • An interactive template which, based on the information declared by a user about the resources planned to be involved in order to implement the investment, makes an economic assessment of the investment • The tool should consider both the savings and costs to be borne by a user (e.g. software, CDE, training) • The introduction of a logging option will enable the analysis and recording of various project delivery options and the selection of the most economically advantageous one
Calculation basis	<ul style="list-style-type: none"> • Data from BIM pilot projects • Reports on the economic viability of construction projects • Benchmark costing (costs of services and materials)

3.4.12 "Templates for BIM software"

Standardisation is one of the main elements that Project stakeholders have identified during the consultation process as key to the effectiveness of BIM implementation in Poland. It seems that - after the development of appropriate legal regulations and good practices in this area - it will be reasonable to make the results of these works available to the market representatives in a form allowing them to efficiently implement the software they use.

Objective	Standardisation of documentation and BIM models, support for market users using modelling tools in the preparation of the working environment, in accordance with the principles adopted in public projects
For whom?	Market users using modelling tools (mainly designers)
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • A repository of files containing settings for leading BIM software with the possibility to download (including their archive versions) • Updating with the release of the next software version • Reporting irregularities in the functioning of the template for the BIM software and starting technical support service responsible for their removal
Resources	<ul style="list-style-type: none"> • A repository of files containing settings for leading software (e.g. content and form sheets for printing technical documentation) in native formats
Basis for the study	<ul style="list-style-type: none"> • Laws and regulations on the content and form of the construction project • Other requirements deriving from legislation, in particular construction law

3.4.13 " BIM Analyses"

The market investigation of BIM is necessary to guide the implementation process accordingly. It is also appropriate to verify the extent to which the public market is adapting to BIM.

Objective	Enabling the analysis of procurement data in relation to BIM and its publication in the resources of the BIM Platform
For whom?	All stakeholders in the construction industry
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • Data search engine • Possibility to download order data from e-Procurement • Graphical presentation of the results of the analyses carried out • Collecting detailed data on the use of BIM in public procurement (development of dedicated BIM forms) • Possibility to create reports on selected data from a user or platform operator level
Resources	<ul style="list-style-type: none"> • Data obtained from e-Procurement including information on the use of BIM

3.4.14 "News"

There is currently an increasing number of initiatives taken and supported by public entities to standardise and implement BIM. The creation of a "notice board" about them will allow to coordinate the actions taken and prepare the market for their effects.

Objective	Intensify efforts to inform the industry about initiatives taken and their progress over time
For whom?	All stakeholders in the construction industry
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none"> • Publication of information on activities undertaken and supported by public entities within the scope of BIM, e.g. training, conferences, publication of reports on analyses or studies, BIM implementation and standardisation initiatives in the construction industry, progress of these initiatives • A notice board providing information on important events on the Platform, e.g. publication of documents in the resources of the "BIM Documents" module, publication of films in the resources of the "Video" module, publication of e-learning courses in the resources of the "E-learning" module, launching the consultation process

3.4.15 "Pilot projects"

In order to inform the market about the number, progress and conclusions of pilot projects carried out as part of activities aimed at implementing BIM in Poland, it is recommended to create a module containing this information.

Objective	Ensure wide access to information on ongoing pilot projects, including the conclusions of their implementation ("lesson learnt" implementation ⁵⁵).
For whom?	All stakeholders in the construction industry
Access	Public resources
Assumptions about content/functionality	<ul style="list-style-type: none">• Publication of information on activities undertaken under pilot projects• Published information should include at least: general project description (size, scope of BIM application, standards other BIM documents used), information on the project delivery (subsequent steps, e.g. notice of a procedure for selecting a contractor, completion of design, visualisations), results achieved and conclusions from the implementation

Detailed description of functionality of the modules will be developed on the next stage of the Project.

⁵⁵ In a nutshell, it consists in the analysis of completed tasks, drawing conclusions from them and their implementation in subsequent tasks.

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