Acta Sci. Pol.
Architectura 24 (2025), 70–91
aspa.sggw.edu.pl ISSN 1644-0633 (suspended) eISSN 2544-1760 DOI: 10.22630/ASPA.2025.24.6

ORIGINAL PAPER

Received: 10.02.2025
Accepted: 04.03.2025

A CRITICAL REVIEW OF THE IMPLEMENTATION OF BUILDING INFORMATION MODELLING (BIM) IN CONSTRUCTION PROCESSES IN POLAND: DEEP INSIGHTS

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ABSTRACT

The increasing digitisation of the construction industry is generating global interest in building information modelling (BIM) methodology. Recognising the tangible benefits it brings, many countries are choosing to begin work on implementing the so-called mandate, defining national implementation plans and introducing legal regulations. The purpose of this article was to conduct an in-depth study and literature search on the current state of BIM implementation in Poland. As part of a structured implementation of the work, the previous activities of central government bodies towards the so-called BIM mandate were examined. The ongoing optionality of BIM application in public procurement is shown, as well as the lack of coordinated top-down activities, as they play a major role towards national implementation. In addition, the relevance of NGO activities in the process of popularising BIM was presented. As a result of the critical analysis, an assessment and discussion of the possible future directions of BIM implementation in Poland was made.

Keywords: building information modelling, BIM mandate, implementation, adoption, construction process

INTRODUCTION

Digital technologies are having a significant impact on the development and shaping of various sectors of the economy, including the construction industry. Influenced by the rapidly changing market and its needs, construction information is becoming an even more valuable resource than ever. As demand increases, the change is to be provided by the building information modelling (BIM) concept. The concept, which accompanies the entire life cycle of a building, introduces fundamental changes to the entire existing philosophy of the property development and construction process. It refers to new technology for information modelling and a process that provides tangible benefits for all players and areas in the architecture, engineering, and construction (AEC) industry. Developments resulting from the digitisation of the construction industry and the need to guarantee a higher quality of information have generated global interest in a methodology that changes the entire previous approach to the implementation of a construction project.

Many countries have begun to recognise the potential of BIM, and therefore, work on its implementation has begun, defining national implementation plans and introducing appropriate regulations. As a result, different

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approaches to supporting the process have been formed, such as recommendations for the use of BIM (optional approach) and provisions for mandatory supplementation of the contract with the use of the methodology in the procurement (mandatory approach). Among the leaders in the use of BIM are countries such as the United States, Australia, the United Kingdom, and Singapore. The multi-year strategies drawn up by the countries, the pilot programmes conducted, and the standards developed still serve as a model and basis for BIM adoption in other public sectors around the world. Significantly, the public sector is cited as a key initiator and overseer of the implementation and promotion of BIM among stakeholders (Cheng & Lu, 2015).

Development work commissioned by government agencies that includes any study and analysis of the feasibility of implementing BIM at the national level is referred to as top-down activities. By design, they are intended to lead to mandatory use of BIM in procurement. Currently, 29% of European countries have or plan to make either full or partial provisions for mandatory use of the methodology in public procurement. In contrast, 6% require or will require BIM in contracts in selected public institutions (Mitera-Kiełbasa & Zima, 2024a). The national implementation process meets broad and multi-level support to cover the entire construction market systematically, including at the international level. An equally important task is to effectively raise interest among more potential users of the methodology. The international expansion of BIM is taking place, regardless of whether the national level is interested in the methodology or not. Therefore, with time, a grassroots initiative is also being singled out. This includes any activity related to the adoption of BIM for the internal needs of the company and includes ongoing educational tasks. Bottom-up activities drive top-down activities, and in the case of Poland, they play a particularly important role. On the other hand, compared to other equally developed markets around the world, Poland still has not implemented the mandatory use of BIM methodology in public procurement. The plans developed so far, as well as the prospect of introducing the methodology from 2025 to contracts with a minimum value, might be a vision that is highly likely to be postponed, resulting in a process that will continue to remain at a working stage. Although against the background of Central and Eastern Europe, implementation work is not undertaken in countries virtually at all, the Czech Republic is an example of a country with a similar level of GDP to Poland; the first BIM mandate was introduced in 2023.

MATERIAL AND METHODS

The execution of the work was based primarily on literature research by evaluating and validating existing content. The basis of the study was the compilation of all events and initiatives related to BIM in Poland in absolute chronological order, and this, in turn, allowed us to proceed to the next stages of the research (Fig. 1).

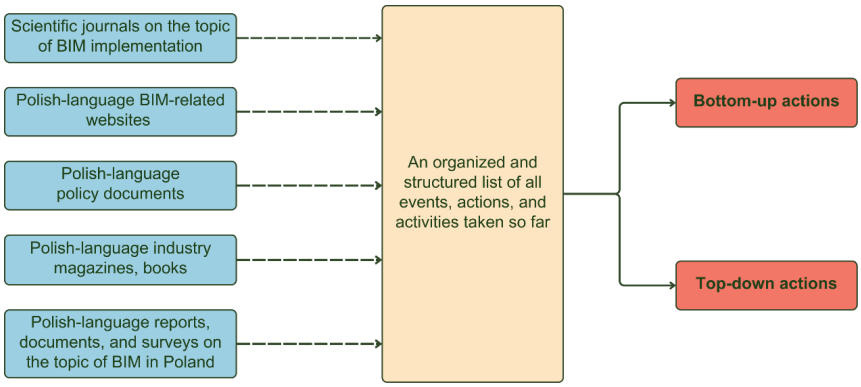

Fig. 1. Research workflow

Source: own work.

The study identified all parties, actors, participants and stakeholders influencing the implementation of BIM in Poland. A reliable check of the bottom-up and top-down activities carried out made it possible to determine the events that have a particular impact on raising awareness in the context of using BIM in the property development and construction process. From the scope of grassroots activities, the most relevant sections were identified, and their topics were discussed and evaluated, and the relevance of their further implementation was argued. Domestic activities were analysed from the legal point of view and in terms of the general interest of government institutions in the subject matter undertaken. The entire article was subjected to observations, reflections, and considerations, and it was topped off with an element of discussion and consideration of the future of the methodology's implementation in Poland.

RESULTS

Grassroots activities

In Poland, it is undoubtedly fundamental to spread the knowledge gained from the implementations among practitioners, primarily through grassroots initiatives. In addition to the associations of architects or civil engineers that have been in existence for more than a dozen years, organisations have also begun to emerge whose guiding purpose is to support and educate strictly in the BIM methodology. This is even more important because the direction set by the pioneers of the BIM concept taken up in Poland resulted in the need for more potential implementing companies to rely on their experience. The demand for education and further qualifications of current and future designers from the use of the new technology was high, and the training opportunities were limited. The beginning of the 2010s was still dominated by training courses organised by partners of software vendors (Anger, Laguna & Zamara, 2021). It can be said that the awareness built up even though the very definition of BIM was limited to understanding it only in terms of new applications and technological innovation in construction, which is expected to bring certain benefits. There have also been cognitive errors in the context of BIM implementation, such as if it is only a concept meant for large companies and large-scale developments or if the moment for implementation is still too early (Miecznikowski, 2014d).

The activities leading to the consolidation and systematisation of the idea of BIM in Poland can be reduced to one slogan – education. In turn, it can be further expanded to include publications, conferences, trade fairs, meetings, debates, training, courses, workshops, lectures, presentations, seminars, research and development, guides, certification, books, manuals, industry blogs or support in starting new majors and specialities at universities. The grassroots initiative just carried out was and still is a fundamental factor in the drive to digitise the Polish construction industry and push forward national activities, which are still scarce. The earliest publications were already based on the popularisation of the paradigm and identified the need for further development of methodology and technology with the participation of, among others, standards bodies and legislative bodies (Miecznikowski, 2013). Moreover, several well-conducted foreign implementations in countries such as the United Kingdom, the United States, Ireland, and the Scandinavian countries were strongly pointed out, which can provide a source of proven practices and be the basis for applying the BIM requirement in Poland as well (Dorna & Glema, 2016; Mitera-Kiełbasa & Zima, 2024b). On the other hand, seeing insufficient response from the national level, experts began to use the experience gained primarily by directing all activities to the main potential audiences and users of the methodology. In the pursuit of digital transformation, the main goal is to reach the most interested parties, raise awareness, and teach and share the current state of knowledge. Hence, existing and emerging organisations and associations have begun to adapt to the changing market, setting further or new guiding objectives for their activities.

According to Figure 2, the organisations formed in the first years of the 21st century mainly resulted from economic growth and the need to support and protect the professional interests of members in terms of changing laws, joining the European Union and the requirement to comply with EU standards, as well as the generally

resulting need to professionalise the construction industry in Poland. One can observe a confirming relationship between any major contact with the concept of modelling information about a building and the resulting need for education in Poland in the 2010s. At that time, organisations were formed that brought together companies and people primarily associated with BIM – the BIM Cluster, the BIM Association, the ECC BIM Foundation, and the Polish branch of the buildingSMART Association.

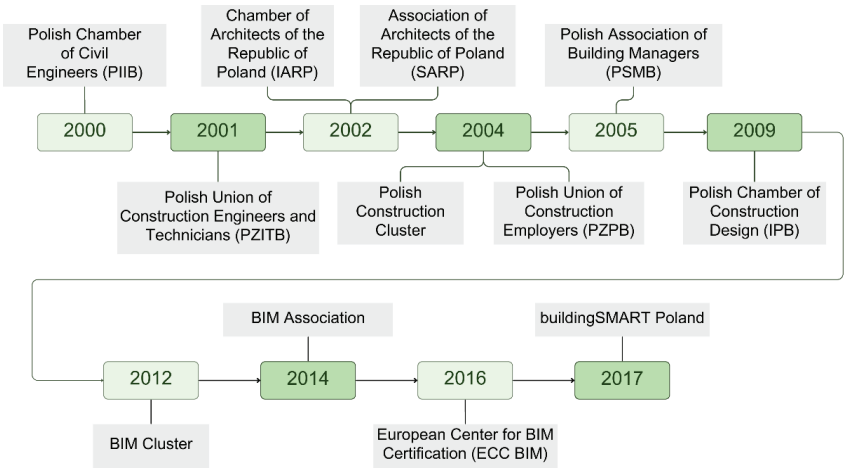

Fig. 2. NGOs working on grassroots initiatives for the development of BIM methodology in Poland

Source: own work.

As a grassroots initiative, various collaborations were established between organisations, and teams were set up to enforce the set goals and objectives for the implementation of BIM in Poland (Fig. 3).

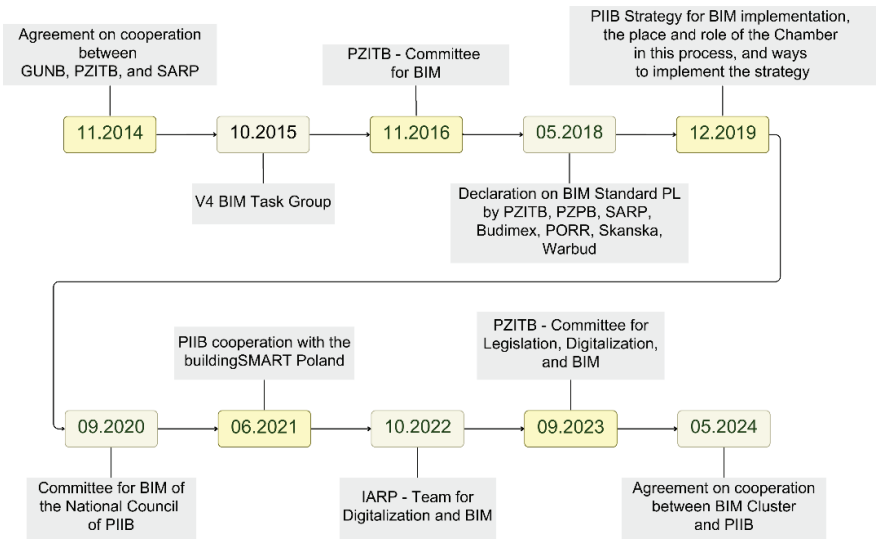

Fig. 3. Important initiatives leading to the popularisation and shaping of BIM methodology in Poland

Source: own work.

One of the first and most significant agreements was the cooperation established in 2014 between the Polish Association of Construction Engineers and Technicians (in Polish: *Polski Związek Inżynierów i Techników Budownictwa* – PZITB), the Association of Polish Architects (in Polish: *Stowarzyszenie Architektów Polskich* – SARP), and the Chief Inspector of Building Supervision (in Polish: *Główny Urząd Nadzoru Budowlanego*). The last page of the agreement is particularly significant, as an agreement was signed on behalf of the government and is seemingly much closer to the digitisation of the construction process, especially in terms of adjusting the Public Procurement Law. The agreement was about strengthening cooperation, as well as giving opinions and pointing out inaccuracies in the provisions of acts and regulations (Inspektorat Nadzoru Budowlanego, Polski Związek Inżynierów i Techników Budownictwa & Stowarzyszenie Architektów Polskich [INB, PZIiTB, SAP], 2014). In turn, a specially appointed team of experts set a framework for action and recommendations for the process of BIM implementation in ongoing public procurement (Anger, Lisowski, Piwkowski & Wierzowiecki, 2015). Defining such tasks is extremely important to make all stakeholders aware of the necessary amount of work that needs to be done to gradually move towards the jointly set goal. Shortly thereafter, the main result of the cooperation was the creation of the V4 BIM Task Group, an ambitious concept involving the Visegrad Group countries, which was to participate in the drafting of recommended standards (Ustinovičius, Wierzowiecki & Puzinas, 2016) and the development of a BIM education programme (Piwkowski, 2017). In contrast, there have been virtually no more significant group activities since 2016. Another major declaration of cooperation was an agreement between NGOs (PZiTB, PZPB, SARP) and companies from the construction industry (Budimex, PORR, Skanska, Warbud) in the context of developing a BIM document called BIM Standard PL. The draft and its appendices were published in 2020. The manual is a set of proposals and recommendations on the preparation and implementation of BIM methodology in construction projects, in the creation of which the Public Procurement Office (in Polish: *Urząd Zamówień Publicznych* – UZP) also participated. In addition to the tangible effects of cooperation, internal activities of associations and clusters should also be identified as important developments. Particularly in recent years, there has been a noticeable increase in the number of established committees, teams, and published action plans among basically all associations. Starting with the strategy of the Polish Chamber of Civil Engineers (in Polish: *Polska Izba Inżynierów Budownictwa* – PIIB), where the postulate was to define the direction of implementation of the established goals in the field of digitisation of the construction process, legislation, standardisation, and popularisation of BIM. The Chamber pledged to be active in virtually all areas of work on the implementation of the methodology. The drafted document presents conclusions on the scope of activities to date and identifies challenges and risks arising from the BIM implementation process (Polska Izba Inżynierów Budownictwa [PIIB], 2019). Similar goals are being addressed by the following task forces that have been formed: the BIM Committee (which implements the Polish Chamber of Civil Engineers Strategy), the Digitisation and BIM Team (IARP), the Committee on Legislation, Digitisation and BIM (PZITB) and the committees operating in the district chambers. The growing number of these bodies indicates that the coordination of inter-agency cooperation activities is intensifying. Cooperation undertaken between organisations gives the opportunity to mutually spread the most up-to-date knowledge, along with greater opportunities for undertakings in the direction of popularisation of the methodology. Therefore, for example, the buildingSMART Association supports this process based on the continuous development of open communication standards, and in cooperation with the Polish Chamber of Civil Engineers, it is possible to disseminate the openBIM approach, at least in trade journals (Rydzy, 2021). Another important milestone is the initiative carried out by the ECC BIM foundation concerning the translation of the multi-part standard PN-EN ISO 19650 (Magiera, Czaplejewicz, & Wala, 2021), which was completed in 2024.

A component of the tasks carried out is also taking part in organised events. Representatives of companies and industry specialists promote the implementation of the methodology in speeches, lectures, talks, and workshops, as well as discussions of various case studies. The first time the topic of building information

modelling appeared at a conference was in 2012. Certainly, in the first years, from among the main organisers one can point to software manufacturers and vendors and their partners (including Autodesk, Graphisoft, WSC, Procad, MAT IT Services) on occasion promoting applications and tools dedicated to designers. Focusing only on selling a product to improve the design process may have overlooked the true idea of BIM, especially in the first editions. Many of them were one-off events dedicated to BIM technology. As time went on, there were more and more related threads, and gradually, conferences devoted entirely to BIM methodology began to be implemented on a national level. Of such organisers, one can mention the BIM Cluster or the ECC BIM Foundation, among others, and thanks to cooperation with an experienced background of specialists, it is now standard that part of the programme involves presenting the directions in which BIM is heading – the idea of a digital twin or expansion to other systems and technologies. Moreover, most events are held periodically, at least once a year, and those shown in Figure 4 systematically continue in subsequent years. The popularity of the conferences also brings together representatives of foreign companies sharing international practices and experiences. In turn, participants are provided an opportunity to update or supplement their knowledge and to expand their contacts with other BIM enthusiasts, users, and beneficiaries.

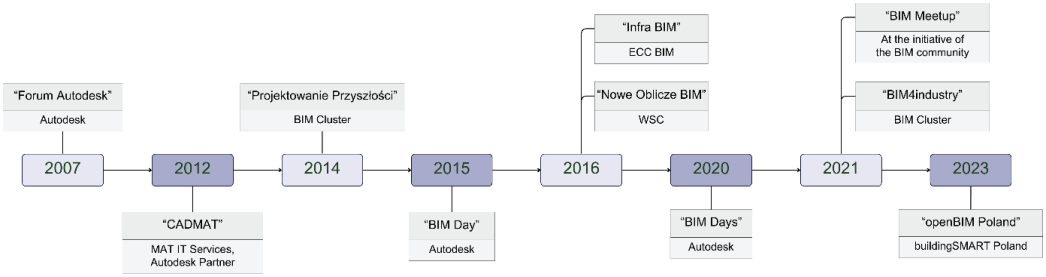

Fig. 4. First editions of conferences devoted to BIM methodology in Poland, along with their organisers

Source: own work.

Upgrading BIM skills in Poland is an indispensable part of the topics of discussion and plans for the organisation's strategy (PIIB, 2019). This applies to retraining incumbent workers and educating those at the secondary and higher education stages. The work on implementation and the need to ensure high-quality education is included, among others, in a project called BIM Education on the initiative of the Polish Association of Construction Engineers and Technicians (part of the V4 BIM Task Group), where there is a commitment in all state technical universities to introduce a uniform core curriculum with BIM included (Piwkowski, 2017). Other associations that participate in the organisation of BIM methodology classes are also members of the ECC BIM Foundation or the BIM Association. The development of an educational programme and support for educating future designers, engineers, and professionals who will be exposed to the BIM methodology is a key procedure to carry out effective and synergistic implementation of BIM in Poland. To chronologically organise the activities undertaken, the graphic (Fig. 5) lists: the first taught subject on BIM technology, the first BIM specialisation, the first BIM postgraduate courses offered at public and private universities, the unified core curriculum on BIM teaching, and the first BIM course in first- and second-level studies. It is worth mentioning that the last two items mentioned in the list are in the Integrated Qualifications Register (in Polish: *Zintegrowany Rejestr Kwalifikacji*) (Zintegrowany Rejestr Kwalifikacji [ZRK], n.d.). Currently, several BIM-related majors have been launched at universities, offering both practical and theoretical education, and the course offerings also include expanded material to include human resource management and business psychology (Mazovian OIIB, n.d.).

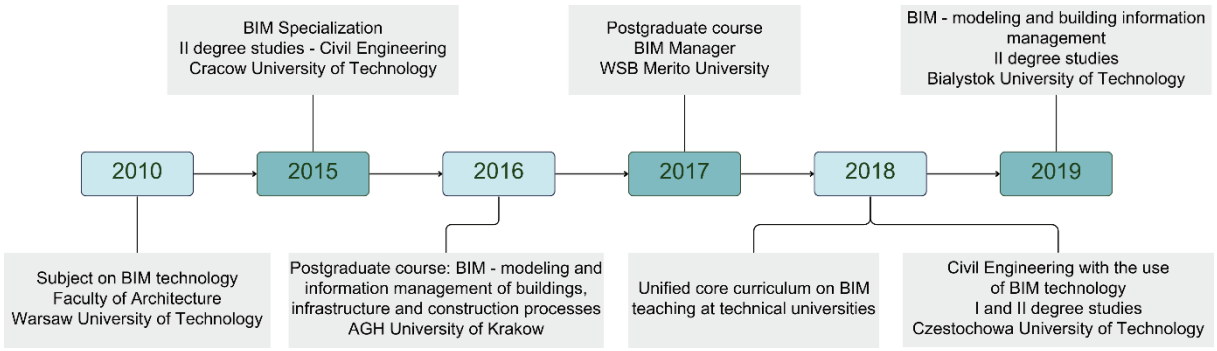

Fig. 5. First initiatives at universities for BIM education in Poland

Source: own work.

The published manuals were intended to be repositories of knowledge on which students and users of the methodology were to base their knowledge. The first Polish edition was published in 2015. According to the educational plan of universities, the first and, at the same time, the most important publications were supposed to fulfil the task of the main literature item (Piwkowski, 2017). On the other hand, they appeared infrequently (Fig. 6). The most necessary information contained in them includes: a discussion of the difference between CAD technology and BIM, dimensions and maturity levels of BIM, the idea of open standards, implementation of BIM in a construction project, and further prefixes for information modelling (Tomana, 2016; Kasznia, Magiera & Wierzowiecki, 2018).

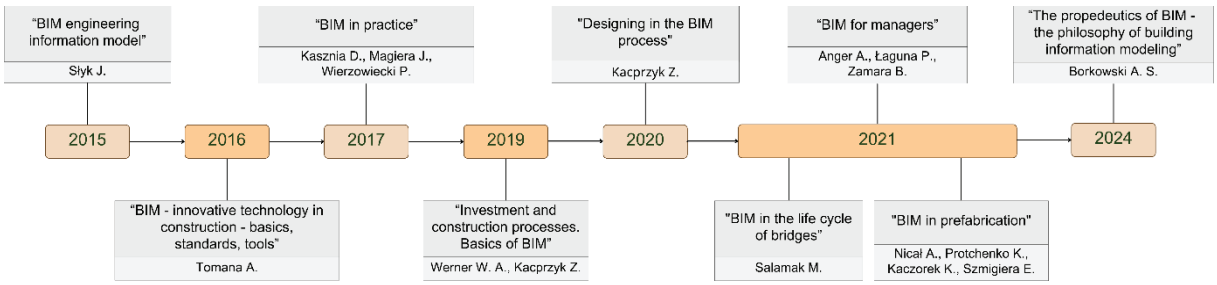

Fig. 6. Polish editions of books discussing building information modelling

Source: own work.

Over time, works have begun to describe BIM more broadly: for specific industries, from the perspective of the role occupied in combination with subsequent systems, and identifying the development trends of the methodology (Salamak, 2021). Undeniably, there are few Polish books on the subject. From the content of the published books, it can be concluded that the topics covered in them are mostly established textbook knowledge with little variation – even more reason for this in the case of the current situation in Poland regarding the application of BIM methodology in the property development and construction process. In contrast, more tailored and up-to-date publications can be found in blog entries at (BIM blog, n.d.; BIM4u.eu, n.d.).

Optional approval of the use of BIM

By 2014, interest in the BIM methodology was gradually growing within individual enterprises. The first construction projects using BIM were also observed. Grassroots activities successfully began to be accentuated in many areas, such as in the topics taken up at conferences, among others. On the other hand, no matter how optimistic the vision of promoting the almost inevitable change in the construction industry and the resulting development work for BIM methodology in Poland, it was alarming that these activities were insufficient (Miecznikowski, 2014a). This was particularly highlighted in situations where uncoordinated marketing efforts by software partners were an element that made it extremely difficult to build awareness of the methodology properly. Moreover, the rapid and haphazard introduction of technology along with the belief that investing in software would be a sufficient step to increase process efficiency, among other things, was another of the many cognitive errors mentioned. Therefore, the necessary work was also carried out from the bottom-up in terms of obviously promoting the functionality of the application, but also spreading the much greater benefits carried by the assumptions of BIM (Olszewski, 2013). In addition to this, this period also saw the presentation of BIM Vision, a Polish browser application widely known in the market today, giving designers another basis for realising a project not only for individual needs (open IFC format), along with cost estimation in BIMestiMate (Zima & Leśniak, 2013).

The work done undoubtedly laid a solid foundation for further development, so it was even more important to arouse interest in BIM at the government level. This was especially warranted when observing foreign implementations at the national level, which at that time had either defined a clear framework for implementing the methodology or were already maturely applying it. It is not without reason that 2014, above all, was marked by an optimistic outlook for increased involvement of the domestic side. The basis for the actions taken in the next 10 years in Poland is the adopted European directive of 24 February 2014 to recommend the use of electronic construction data modelling tools in public procurement: 'For public works contracts and competitions, Member States may require the use of specific electronic tools, such as electronic construction data modelling tools or similar. [...]' (Article 22, Paragraph 4 of Directive 2014/24/EU).

The adopted Second Directive 2014/25/EU on procurement by entities operating in the water, energy, transport, and postal services sectors also contains the same provision (Directive 2014/25/EU). The directive gave member states a choice in deciding whether to use technology in public procurement. Implicit in this provision is the issue of allowing the use of BIM methodology on an optional basis. At the start of 2014, the direction towards which the Polish government would, in principle, head was given, and an opportunity to accelerate national action also arose. Therefore, special attention should be paid to the first months after the publication of the directive, analysing the observed activities as well as the government's overall approach to the matter of implementing the methodology at the national level, even more so because the issue of structuring the implementation of BIM into an appropriate framework for action involves many players and requires cooperation among them. Hence, we can distinguish (according to the current naming of offices): the Ministry of Development and Technology (in Polish: *Ministerstwo Rozwoju i Technologii* – MRiT) – including the Public Procurement Office (in Polish: *Urząd Zamówień Publicznych*), which is subordinate to it – together with the Department of Architecture (in Polish: *Departament Architektury*), Construction and Geodesy; the Ministry of Infrastructure (in Polish: *Ministerstwo Infrastruktury* – MI); and the Ministry of Science and Higher Education (in Polish: *Ministerstwo Nauki Szkolnictwa Wyższego* – MNiSW), together with central administrative bodies supervised by the mentioned ministries, among others. In addition to this, it is necessary to determine the extent to which the methodology has been used in construction projects carried out at the time and to check the presence of a possible provision in public procurement. The distinguished components that played the most important role after the publication of Directive 2014/24/EU are shown in Figure 7.

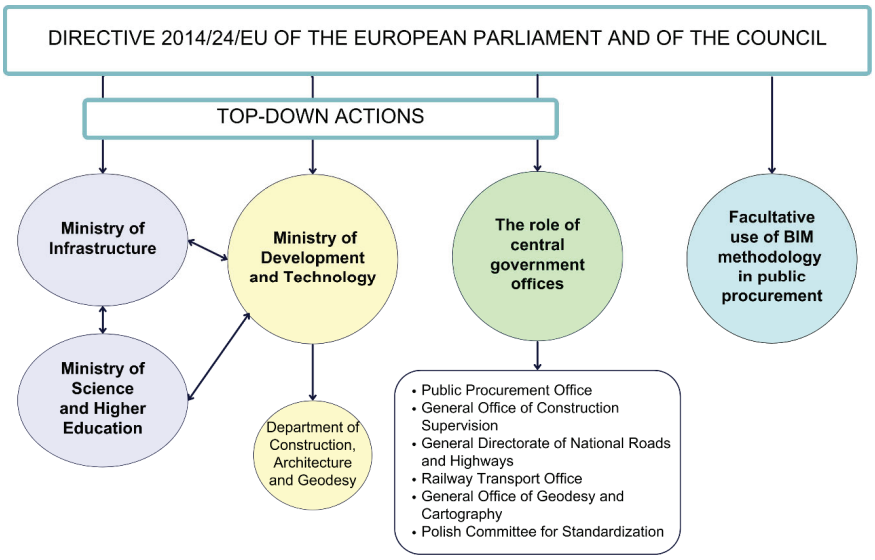

Fig. 7. Activities and actors integral to the implementation of the BIM methodology in Poland after the publication of Directive 2014/24/EU in the following years

Source: own work.

Expectations for defining a national stance on BIM implementation were high from the very beginning. Therefore, it should be emphasised that the popularisation process of BIM was quite quickly connected directly with the practice in the UK, among other things because of the Association of Polish Engineers and Technicians operating there. The consultations that were carried out created many opportunities to take up the topic of implementation or minimal familiarisation with the new approach to the construction project in progress. On the other hand, none of the representatives of public sector clients were interested (Miecznikowski, 2014b). In addition to this, it was possible to get to know from the very beginning a rather clear approach to the topic of the direct relationship between public procurement and the better quality of the delivered product, for example, during one of the debates at the conference held in April 2014. The issue of political image and the awarding of public procurement with minimal legal risk was put forward over a long--term and strategic approach to the property development and construction process, and the essence of public procurement in general, which should be carried out on the basis of higher goals, if only for the sake of future users (Miecznikowski, 2014c). The European directive, along with the use of electronic tools, describes issues inherent in the BIM concept, such as the entire life cycle of a building and with it the essential criterion for public procurement, which is the criterion of the offer with the best value for money (and not the lowest price as before). Thus, from the first examples alone, it can be concluded that the problematic nature of the entire approach of the central authorities to the implementation of the construction project is even more fundamental, where, as things stood at the time, there were no prospects for addressing the implementation of the BIM mandate in Poland.

On the other hand, from the examples of conducted public procurement proceedings with the provision of the requirement to use BIM for documentation, the first tender of the Museum of Józef Piłsudski project in Sulejówek in Poland is mentioned. Continuing the thought of the problem of the attitude of the parties to the implementation of procurement in the spirit of innovation, the example mentioned was not free of similar problems. From the proceedings, we can detail the failure to adapt the terms of the contract

to the realities of the Polish market, the ignorance of the ordering party and the repeated changes to the content of the announcement, but also the resistance encountered from the main contractors, who cited the lack of the required BIM in Polish law (BIM blog, 2015). Other examples of announced public procurements were tasks in the field of architectural inventory or multi-discipline documentation for construction and detailed design (Orlińska-Dejer, 2017). On the other hand, the literature also popularised public construction projects where BIM was used optionally in the design process (Olszewski, 2014; Olszewski, Gundelach & Jędrychowski, 2014). Despite this, the number of example initiatives to supplement the contract with a record of the use of BIM elements was negligible. Thus, what stands out is the current problem of public sector projects, which is the lack of fundamental knowledge of property developers, and the reluctance of main contractors to implement the contract in BIM. Hence, the issue of addressing the demand for consciously defined standards and the corollary aspect of understanding the actual desirability of receiving the expected final product arises. Undoubtedly, it is desirable to involve the national side in this process and take responsibility for overseeing and leading the BIM implementation process.

One of the central government bodies to which all the mandating of BIM methodology in public procurement comes down is the Public Procurement Office. It is the body that is required to do the most in terms of shaping BIM in the country. As part of the development of the EU directive, a comprehensive 240-page document discussing the modernisation of the regulations was published on behalf of the authority. In the context of the use of digital building data modelling tools, only a provision of the law was rewritten, which was not analysed to any extent (Urząd Zamówień Publicznych [UZP], 2014). Hence, it is necessary to consider this action in terms of wondering how public sector clients could require the use of BIM methodology in the bidding process at all when no uniform field was given to interpret the provision. On the other hand, one must consider the situation of lack of interest in the directive provision due to the absence of any top-down mandated requirement. In turn, there is also the issue of education, which currently is primarily done from the grassroots level.

In contrast, the only education-related activity identified by the central office's initiative was the organisation of a thematic conference in December 2015 on BIM technology in the preparation and implementation of public sector projects. In cooperation with the BIM Association, the Public Procurement Office prepared panels discussing the directive's regulations, the practical use of BIM technology at each stage of a building's life, the BIM Task Group initiative and the openBIM approach in the process. Participants included representatives of the public sector, central and local government entities, and practitioners and experts (Informator Urzędu Zamówień Publicznych, 2015). The conference resulted in the first significant interest in cooperation among smaller municipalities and cities. On the European level, in turn, a task group was funded to harmonise approaches to the use of BIM tools in public procurement across member states. The EU BIM Task Group published, among other things, a handbook with guidelines and a recommendation on key practices, with the accompanying buzzwords being value generation, innovation, and economic growth (EU BIM Task Group, 2016).

After 2014, legislative changes were necessary to adapt the law to EU provisions. The deadline for member states to introduce legislation implementing Directive 2014/24/EU was 18 April 2016. Until then, there was certainly a lack of commitment from the government side and informed decision-makers with whom to work, especially since, given the well-developed parallel grassroots initiative, the opportunities were considerable. The Polish case is, first and foremost, a multi-issue problem. It encompasses many actors with different states of knowledge, and different goals and expectations. The methodology of modelling information about the building can possibly be an answer to these problems, but it seems that the topic of the Polish construction industry has an even more intricate background, which especially requires adequate preparation to adopt a new approach to the implementation of the property development and construction process in the future.

Towards a BIM mandate

The main topic of discussion around the upcoming amendment to the Public Procurement Law was the provision for the use of BIM tools in procurement. The NGO initiative was also present in this regard. An approach negating the obligatory nature of BIM methodology in procurement (*Izba Architektów Rzeczypospolitej Polskiej* – IARP) was present, but there were also observed activities of the BIM Cluster together with the BIM Association, who proposed a revised content of the future law, as did the Polish Association of Construction Engineers and Technicians, and the Association of Polish Architects (Ustinovičius, Wierzowiecki & Puzinas, 2016). On the other hand, despite the efforts, the law was published with an unchanged provision of the European directive, allowing the optional use of digital tools (Article 10e) (Ustawa z dnia 22 czerwca 2016 r. o zmianie ustawy – Prawo zamówień publicznych oraz niektórych innych ustaw). After 2016, one can notice increased initiatives centred strictly around the Ministry of Infrastructure and Construction (in Polish: *Ministerstwo Infrastruktury i Budownictwa* – MIB). At a similar time, there was a parliamentary consultation on the topic of public procurement with a proposal for methods of implementing BIM from the central level. The meeting was held with the participation of specialists from the construction industry, including representatives of universities, the BIM Cluster, the BIM Association, the Association of Polish Architects, IPB, the V4 BIM Task Group, engineers, designers, practitioners working in BIM, as well as legal advisors. Constraints towards national implementation were highlighted, which include procedures incompatible with the assumptions of the methodology, fragmentation of stakeholders, insufficient competence to define requirements in the procurement, and thus, lack of support from specialised advice to public sector clients. In turn, of the actions identified as necessary to be taken, the essence of drawing from foreign experience and adapting existing standards to the specific needs of the Polish market was discussed, as well as the 'indispensable', which is the commitment of the state party to consciously carry out a systemic change in the approach to the implementation of the property development and construction process at the national level. The issue of phasing the implementation process with the introduction of gradual, initially more affordable requirements in public-purpose procurement was emphasised. There were also proposals to draw up templates and contract documents, subsidies, and the appointment of a national coordinator with effective contact with government bodies. The consultations resulted in an interpellation to the MIB (Janota-Bzowski, 2016a; Janota-Bzowski, 2016b). The discussions that were undertaken also mentioned estimating the cost and return on investment for the first implementation of the technology through the development of Malta House in Poznań (Walasek & Barszcz, 2017). Shortly thereafter, on the initiative of the Deputy Minister of MIB, a series of expert meetings on the use of BIM methodology was organised (Builder Polska, 2016). This is the first clearly created opportunity to undertake cooperation between the bottom-up and top-down sides.

At the end of September 2016, a commission was carried out to develop an expert opinion on the possibility of implementing the BIM methodology in Poland, commissioned by the MIB as part of the project '*Wzmocnienie potencjału legislacyjnego w obszarze procesu inwestycyjno-budowlanego* [own translation: Strengthening legislative capacity in the area of the property development and construction process]'. It consisted of an analysis of the current legal regulations regarding the possibility of applying the methodology in public sector projects so that the results would enable the identification of ways to implement BIM in the country from the central level. Foreign practices were presented, among others, on the basis of the British experience, where a special BIM Task Group was established to control the entire implementation process, which was divided into stages; special attention was paid to standardisation of classification; public consultations and meetings were held with stakeholders in the entire process, and pilot projects were implemented involving the Ministry of Justice in the process. The foundation driving subsequent activities to improve national implementation was well-prepared project information. For Poland, on the other hand, KPMG pointed

to a provision in the Public Procurement Law that is at a very general and under-specified level, which can pose a problem in terms of understanding the content and thus make it impossible to require it in procurement proceedings. In addition to this, the scope and method of implementation of the strategy and the necessary basis for the implementation process, which is effective communication with stakeholders, are defined. This implies the need to develop appropriate methods and a plan to lead the dialogue in order to achieve the real involvement of the right people associated with the construction industry (KPMG, 2016).

As a top-down initiative, cooperative consultation activities did not actually continue until 2019. In the middle of the year this time, the Public Procurement Office showed its commitment with a closed workshop meeting on BIM tools in the implementation of infrastructure projects (Urząd Zamówień Publicznych [UZP], 2019a). Further down the line, the same central body organised the BIM Hyde Park, a discussion meeting in proposed thematic blocks (Urząd Zamówień Publicznych [UZP], 2019b). The group of participants again included members of NGOs, representatives of design and contracting companies, and representatives of the public sector. The discussions covered virtually the same topics as the publication of the European Directive five years earlier, namely the issue of regulating the provision of the Public Procurement Law from the use of electronic construction data modelling tools and its interpretation, as well as the financing of a uniform standardisation system and the issue of national involvement in the implementation of pilot projects (Janota-Bzowski, 2019). The circular activities of central institutions can be closed with the publication of a new Public Procurement Law with the rewritten content of the well-known article (Ustawa z dnia 11 września 2019 r. – Prawo zamówień publicznych; Fig. 8).

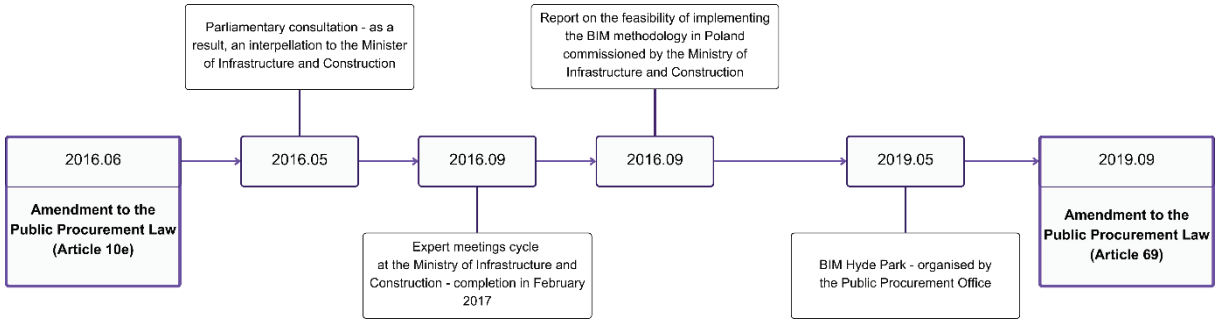

Fig. 8. National steps taken toward a BIM mandate

Source: own work.

Based on the experience of other countries implementing BIM, it was clear that at some point, in the Polish market, it would also be necessary to announce and implement a programme of pilot projects. The identified main projects are shown in the table (Table 1). The selected projects were infrastructure projects. On the other hand, it is well known that BIM technology and tools currently provide better support for cubic buildings, which, in contrast to broadly defined buildings, require the cooperation of a narrower group of specialists from different backgrounds. Thus, the implementation of the aforementioned buildings in BIM technology is not an easy task (Juszczyk, 2022). However, the first pilot was announced for a project selected by the General Directorate of National Roads and Highways (in Polish: *Generalna Dyrekcja Dróg Krajowych i Autostrad* – GDDKiA) (a body under the then Ministry of Infrastructure and Construction), which involved the construction of a slightly more than two-kilometre section of road with the necessary accompanying elements. Preparations involved adapting the procurement requirements to the current state of the Polish market. With the support

of a consultant, participants in the procurement party process were trained, goals to be achieved from the pilot were defined, and a technical dialogue was organised with the main contractors to learn about their readiness to implement the project at the set level. The Employer's/Exchange Information Requirements (EIR) (Karolak et al., 2018) are also included in the tender and contract documents. The mature preparation for the most important project defining the next steps towards the BIM mandate is the only positive element of this construction project. At the time of writing, the final main contractor for the construction of the Zator bypass has still not been selected. On the other hand, further mention can be made of the pilot project for the Polish Railways for the design documentation of the railroad viaduct, which was implemented within two years after the tender was issued.

Table 1. Inventory of the best-known pilot projects since the beginning of the national BIM implementation process

Name of the authority	Project title and scope of work	Year of the first pilot dialogues	Status as of 15 December 2024
General Directorate of National Roads and Highways (*Generalna Dyrekcja Dróg Krajowych i Autostrad* – GDDKiA)	Preparation of project documentation for the task 'Construction of the Zator bypass within the National Road 28'	2016	ongoing (second announcement on contractor selection process)
Polish Railways (*PKP Polskie Linie Kolejowe S.A.*)	Preparation of project documentation for the task 'Demolition and Construction of a Railroad Viaduct at km 33.994 on Railroad Line 140 Katowice Ligota–Nędza'	2016	completed (2020)

Source: own work.

Despite the small number of pilot projects, the Polish construction market has optionally supplemented the provision for the use of BIM methodology in some tendering procedures for public sector projects. Provisions can be found in the technical (geo-referencing, level of detail, file transfer formats such as IFC, specifying the common data environment platform provider, coordination), managerial (how to communicate and share files in a common data environment) and strategic (process control, organisational issues) areas, although this was enforced differently in each case and to a different extent (Zima & Mitera-Kiełbasa, 2021) in addition to the barriers that participants of such projects may face. This paper is a case study of Employer's Information Requirements (EIR). Later, to prevent the differences that may occur at the stage of drafting documents, studies commissioned by the Public Procurement Office as well as the Ministry of Infrastructure were published for contracting authorities and contractors (Ministerstwo Infrastruktury, 2021; Ministerstwo Infrastruktury, 2022; Urząd Zamówień Publicznych, 2022; Kasznia, 2023). However, the mentioned documents are mainly an introduction to carrying out a construction project with BIM, the related terminology, methodology assumptions and basic technical guidelines, which are only a collection of information and guidance. Equally basic recommendations for the contracting authority can be found in the State Procurement Policy of 2022, which also sets out recommendations for the President of the Public Procurement Office to continue educational activities in promoting the use of BIM (Uchwała nr 6 Rady Ministrów z dnia 11 stycznia 2022 r.). The regulation on the scope of data interoperability, which lacks a reference to the IFC standard, is also highly questionable (Rozporządzenie Rady Ministrów z dnia 21 maja 2024 r.).

Attempts to implement the BIM mandate

The preparatory activities for further steps towards the potential implementation of BIM in the country resulted in several significant actions on the part of the central government administration. The essence of this part was primarily to analyse the approach and the general context in which BIM was presented to the audience, as well as the main goal that guided the actions taken by decision-makers. The largest project towards identifying and determining the prospects for future implementation of BIM was the '*Cyfryzacja procesu budowlanego w Polsce* [own translation: Digitisation of the Construction Process in Poland]' project, which was carried out by the former Ministry of Development. The project, which lasted nearly one year, was undoubtedly carried out on the largest scale of activities to date. The study included all participants in the property development and construction process during surveys, meetings, and consultations held to examine and analyse the current state of the construction industry. One of the main objectives was to identify demands for proper preparation and dissemination of best practices carried out by the BIM methodology (Ministerstwo Rozwoju i Technologii [MRiT], 2020a). This was to be helped by workshops with foreign specialists who shared their acquired experience through national implementations. Regular reports and documents were published, presenting the progress of the project work. The resulting studies are mainly aimed at contracting authorities and contractors. An important product is the prepared templates of BIM documents (BIM execution plan or information requirements), along with the discussed standard PN-EN ISO 19650 (Polski Komitet Normalizacyjny [PKN], 2019) in terms of using its elements in the process of construction project implementation. On the other hand, an important highlight is the fact that the documents are strongly based on economic issues. Tomana (2020), in his publication, draws attention to the problem of implementing projects using the macroBIM level. He points out that the documents do not consider the aspect of currently used price lists and what will be difficult at the stage of cost estimation due to their failure to adapt to the requirements of BIM technology. Moreover, they lack a long-term approach, where the most important assumption of the methodology would be included, i.e. the inclusion of the entire life cycle of a building and at least the topic of produced costs (not only financial) during operation. The topics of the project, as much as the actions, would not cover a wide range of stakeholders, but the final conclusions and assumptions are very narrow – to a single, not very clear goal.

Following the example of the UK, a list of elements compiled in a document with the identical name '*Mapa drogowa dla wdrożenia metodyki BIM w zamówieniach publicznych*' [own translation: Roadmap for the Implementation of BIM Methodology in Public Procurement]' was meticulously prepared. A 'strategy matrix' was developed, with components such as technology, cyber security, Lean approach, classification, and ecology. All are considered for each phase of the project process (Ministerstwo Rozwoju i Technologii [MRiT], 2020b). The document presents a timeline with deadlines for achieving the listed components. In addition to this, most interesting is the ambitious milestones set for the presence of BIM in the tender proceedings in question, where, among other things, from 2030 all public procurement would be done using the methodology (Pinkosz & Borkowski, 2023). The document, also called an implementation strategy, is not mandatory. These are merely identified actions to make the audience aware of the importance and essence of BIM and the steps needed for future implementation. The possible updates recommended in the document as to end dates have never happened.

Regardless of the content published earlier, a study 'BIM Standard PL' by NGO authors in cooperation with major contractors and with the participation of the Public Procurement Office (BIM Standard PL, 2020) was also made available in 2020. The publicly available document, intended for cubic buildings, consists of a core part with a glossary of terms and appendices, such as templates or tables for graphic and non-graphic data details. The identified problem with this study is the fact that it is optional and that it is only a proposal

for a standard that can be further improved and introduced with potential national implementation. Further, the theme of the idea of a digital twin, mentioned in the introduction, is not developed virtually at all later on. The vocabulary used is also questionable. Alternatively, one can read about technology, process, and BIM methodology. Despite explanations of these and other terms in the glossary, it is difficult in some cases to find their practical use in the text. The issue of the non-committal nature of the document stands out very strongly. There was no definitive indication of the necessity of creating a Polish classification (Kacprzyk, 2022). There was also a cursory treatment of the file naming standard. By definition, standardisation should be regularly updated, especially because it is an ongoing process. The assumed element of discussion (and the resulting low level of public involvement) with modification and completion of the new version of the manuscript has not been realised so far (Kacprzyk, 2023).

The aftermath of the Digitisation of the Construction Process project was the establishment of the BIM Working Group by the MoD in 2022. The Group existed for more than a year. The Group included people well-known in the BIM community. The activities undertaken can be summarised by the slogan of theoretical enterprise. The reported files mainly include repeatedly identified key issues related to standardisation, classification, standards, preparation of tender documents, support of procurers, and legal changes. The task of the Group was to support the Minister in developing a strategy for the implementation of the methodology (BIM Working Group, 2022). The result of the work worth noting is the '*Koncepcja wdrożenia klasyfikacji budowlanej CCI w Polsce* [own translation: Concept for Implementation of CCI Construction Classification in Poland]'. To achieve consistent data exchange and thus increase productivity, it is argued that CCI classification was chosen because its scheme was developed strictly for BIM. Analysing the Group's work in this regard, one mentions a rather consciously executed study with an indicated constant need for verification, changes and interpretation of the classification. It is, of course, a good effort to refer to the activities of the Polish branch of the buildingSMART Association, which takes care of the maintenance and development of the classification at the international level (Ministerstwo Rozwoju i Technologii [MRiT], 2023). On the other hand, the document was again not binding, and after the breakup of the Group, work on it continued even less.

The current project taking place towards further digitisation of the construction process is the work on the e-Construction web portal, which was launched in 2022. It is a platform for streamlining the work of architectural and construction administration bodies and construction supervision, and the list of construction procedures possible for users has been regulated by law (Ustawa z dnia 7 lipca 1994 r. Prawo budowlane). The assumptions presented on the title site for the digitisation process are divided sequentially into phases of procedures, registers and authorities (e-Budownictwo, n.d.). This is also how other tools are launched over time: a digital construction book (c-KOB) or an electronic construction log (EDB) and others. Currently, the system for administrative procedure support in construction (SOPAB) is being piloted. Ultimately, the system is to be fully integrated with other services, as well as with the General Office of Geodesy and Cartography (in Polish: *Główny Urząd Geodezji i Kartografii* – GUGiK), and the flow of information would take place within the authorities conducting the necessary activities in construction processes (SOPAB, n.d.). The initiative to electrify construction documentation is undoubtedly a necessary process. Nevertheless, the decision to choose the form of submission of applications (for notification, for decision), either in the traditional version or through the portal, is still at the user's discretion. Moreover, when deciding to generate an application on the e-Construction portal, it can still take a paper form to go to the authority as a hard copy, which, in practice, means the continued preference for paper documentation over digital documentation. All attempts at national BIM implementation can be summarised by the statement that none of the initiatives has been officially implemented on the market.

DISCUSSION

The methodology of BIM strongly emanates from and permeates, to a greater or lesser extent, every area of the construction industry's operation. It is now an inherent topic of much discussion and consideration in the approach to the innovative solution, which is permanently entrenched in the minds of many. An undeniable regularity is the fact of the demand for BIM in the drive to digitise the industry. Although it continues to find its opponents and sceptics, the cause of realising certain higher goals should be guided beyond any doubt. In Poland, the benefits of the described methodology are gradually being noticed. An analysis of the current state of national implementation has shown that it is still in the initial stage of implementation work. The identified actions taken over the past years resonated strongly among those involved. Unfortunately, their multitude remained ununified and uncoordinated. The degree of fragmentation of the entire process with stakeholders is considerable.

The adoption of BIM in Poland has been going on for almost twenty years. From the earliest implementations in the Polish branches of foreign companies to waiting for guidelines on standardisation and defining a binding strategy for implementing BIM in public procurement, this period is still growing. During this period, and especially in the first years, the initiative was taken by companies from the AEC industry, which began to adapt the methodology to their own needs. The first implementations took place in large companies with the possibility of investing in new technology and training. I mention technology here because it is where the definition of the new concept that could potentially replace CAD technology and paper documentation begins to take shape in Poland. Inevitably, BIM began to be reduced to the use of new applications and design tools. The accumulation of training offered by software manufacturer partners has turned BIM into a marketing activity rather than an idea introducing a new evolution after the computer-aided design stage. Implementation has led to the development of internal know-how in companies to a greater or lesser extent – sometimes also with a view to reserving it (Borkowski, Nurzyńska, Sender & Wiosna, 2024) – leading to a situation in which companies now admit to using BIM, regardless of whether it is required in the project or not. Ultimately, the benefits of such an implementation will never be maximised, especially when it is at a low level of maturity. The BIM methodology has not been developed solely for individual use; however, BIM now plays an indispensable role in creating new, innovative directions and design ideas. Being competitive in the construction market is an undeniable added value, although one should also consider the issue of some participants in the construction process who, above all, do not notice the wide range of benefits brought by the methodology and, moreover, are convinced of the correctness of many cognitive errors.

Awareness of the possibilities and advantages of BIM implementation increases over time. The very process of popularisation and the stages of development of methodology can be observed in the most frequently cited studies organised periodically by Autodesk. In particular, the different entities show a changing level of BIM awareness over the years, which is also stated in the report (2019 – 38.3%; 2023 – 58.8%) (Autodesk, 2023). This is the average response of those surveyed to the question regarding their contact with BIM methodology in their professional work. The percentages are promising, but as the study shows, practical skills are not enough to fully understand the methodology or to achieve all the benefits it offers. This fact, in turn, was addressed in the subsequent questions of the survey, and there is indeed reason to be optimistic in this respect: the low level of knowledge about BIM (2015 – 60.2%; 2019 – 68.4%; 2023 – 74%) was the main barrier to the implementation of BIM in Poland among respondents (Autodesk, 2019; Autodesk, 2023). Bottom-up activities are effective in shaping the Polish market for the 21st century. This is particularly evident when the use of BIM in individual units is already quite systematised, and in the latest survey, the surveyed process participants (architectural, design, construction companies, developers, managers) also point to the low awareness of the benefits of BIM among developers as another barrier (2023 – 72%) (Autodesk, 2023). A further step towards readiness to enforce the BIM requirement in procurement is evident.

Thus, it is stated that the necessary continuation of educational activities for BIM in the country is needed. The dissemination and sharing of valuable experience should remain a priority in the field of NGO activities. Well-established knowledge and awareness of the assumptions of the BIM methodology among professionals, practitioners and adepts should be strongly emphasised at organised conferences, in published content in trade journals and generally be promoted among the community. The pressure exerted with increasing intensity will result in the presence of BIM in more areas of the industry's operation. As time goes on, there will certainly be an increase in the number of implementations being carried out in design and contracting companies. If the current minimal national interest continues, the disparity between individual use of BIM and its application in public procurement will widen. Companies will develop internal standards for conducting the property development and construction process, which will cause further chaos and possible inaccuracies in interprofessional cooperation and in the implementation of further stages of the project. On the other hand, the competitiveness of Polish companies in the international arena will be increased, and new trends in design, applied solutions on construction sites, and approaches that meet the goals of modern construction will be developed. How independently the bottom-up initiative will still be carried out from the top-down depends solely on the national side.

The prospect of implementing the methodology in public procurement remains at the stage of clumsy attempts to study the needs and opportunities of the construction market. The non-committal nature of the projects, consultations and documents presented have been noted in all the activities undertaken. A standout issue is the continued wait for a decision on the start of a centrally monitored BIM implementation process. The continually maintained optionality of activities will not lead to coordinated implementation. In addition, it is also impossible to achieve measurable results when the electronification of construction documentation remains unmandated. Thus, paper documentation figures will continue to persist: on average, 0.03 M m^3 of storage space is needed annually to store documents for handling construction permits (Rynek Instalacyjny, 2023). Therefore, what is needed is a decision from the government level that will include experienced individuals in the implementation process, and top-down actions will consistently complement bottom-up actions. Toward the mandatory application of BIM in public procurement, activities in the area of standardisation, issuance and dissemination of construction classification in accordance with BIM methodology, along with the development of a good practice manual to support companies implementing BIM, are essential. As in the Czech example, a national knowledge repository (Borkowski, Drozd & Zima, 2024) can also be a basic element. Regularly updated and publicly available handbooks, manuals, and guides can provide the basis for a standardised approach to the implementation of a construction project. In turn, the training of local government units can be carried out along the lines of the training organised by the Ministry of Development and Technology on the future reform of planning and spatial development in Poland (Ministerstwo Rozwoju i Technologii [MRiT], 2024). With the decision to make BIM mandatory in the future, legislative changes should be an integral part. The Polish construction market will not begin to treat the digitisation of the construction process with due respect until there is an amendment to the law making the application of the methodology mandatory in each public contract. The national implementation process should be properly planned and maturely carried out. Real incentives for the use of BIM should be present, properly rewarded in non-price criteria, and subsidised from the governmental and European levels.

A holistic view of the topic of BIM implementation in property development and construction processes has shown that the issue of Polish implementation is very intricate. Significant action is needed in the near term to prioritise the implementation of BIM methodology. A binding decision is needed to start developing a long-term plan supported by the government. It may also be important to take foreign experience into account and realistically set end dates for achieving milestones based

on that experience. An implementation strategy should be drawn up as soon as possible since, apart from the domestic side, there are presently no major oppositions that are hampering the process. A key element should be an independent entity acting for the general good, responsible for overseeing and evaluating the implementation process. In turn, bottom-up action only with top-down action can allow for effective and consistent methodological awareness building.

It is necessary to continue to observe the construction market. As it is one of the least digitised industries in Poland, the constant development of technology and the growing demand for the implementation of advanced construction projects will force adaptation to the requirements of the market. Thus, one can already see attempts to assess individual possibilities of implementing the methodology among procurers, as in the PKP PLK Company launching the BIM Working Group (PKP Polskie Linie Kolejowe S.A., 2024). This shows that interest in BIM is growing, while it is possible that this will lead to the opposite effect, which will be completely different than expected. The demand for BIM is high. Therefore, one of the effects of implementation work in the long term will be to ensure the country's competitiveness on the international stage. In turn, the preparation of future specialists should constantly be based on a uniform curriculum at universities.

CONCLUSIONS

The critical nature of the work has highlighted all the inaccuracies of the existing approach to the topic of mandate implementation in Poland. Building information modelling methodology represents a huge opportunity for the digitisation of the construction industry. Therefore, it is even more desirable to have a responsible body that would guarantee a decision on the coordinated implementation of BIM, starting with public procurement of a specific value. The realised assumptions about the work undertaken were made possible by in-depth literature research. Expanding the analysed content with sources that went beyond formal documents and legal acts made it possible to make a factual assessment of the state of BIM implementation in the country. Thus, inferring the subject matter taken up, the degree of progress on the BIM obligation is minimal. In the current situation, it is even necessary to reorganise the steps towards the mandate. It is necessary to build a fundamental base that assumes the entire life cycle of a building while realising the objectives of European policy and global trends in construction. The approach that assumes only calculations of the potential cost of a product alone should be abandoned. More attention should be paid to the individual – the future user of the construction project, where the greatest tangible and intangible costs of maintaining the building are generated in the operation and management phases. It is advisable to think with much more care about the future, with the prospect of creating digital twins of buildings, and eventually extending to larger areas, such as cities.

Acknowledgements

We would like to thank the Faculty of Geodesy and Cartography at the Warsaw University of Technology for their support in the execution of this work.

Authors' contributions

Conceptualisation: A.S.B. and G.B.; methodology: A.S.B. and G.B.; validation: A.S.B.; formal analysis: G.B.; resources: G.B.; data curation: G.B.; writing – original draft preparation: A.S.B. and G.B.; writing – review and editing: A.S.B. and G.B.; visualisation: G.B.; supervision: A.S.B.; funding acquisition: A.S.B.

All authors have read and agreed to the published version of the manuscript.

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PRZEGLĄD KRYTYCZNY WDROŻENIA MODELOWANIA INFORMACJI O BUDYNKU (BIM) W PROCESACH INWESTYCYJNYCH W POLSCE: DOGŁĘBNE SPOSTRZEŻENIA

STRESZCZENIE

Postępująca cyfryzacja branży budowlanej powoduje globalne zainteresowanie metodyką modelowania informacji o budynku (BIM). Wiele krajów z racji, że dostrzegło niesione przez nią wymierne korzyści, zdecydowało się na rozpoczęcie prac nad implementacją tzw. mandatu. Oznacza to określenie krajowych planów wdrożenia oraz wprowadzenie regulacji prawnych. Celem artykułu było głębokie studium i kwerenda literatury dotycząca aktualnego stanu wdrożenia BIM w Polsce. W ramach usystematyzowanej realizacji pracy zbadano dotychczasowe działania centralnych organów administracji rządowej w kierunku tzw. mandatu BIM. Wykazano chronicznie podtrzymywaną fakultatywność stosowania BIM w zamówieniach publicznych, a także brak skoordynowanych działań odgórnych, jako że odgrywają one główną rolę na drodze krajowej implementacji. Ponadto przedstawiono istotę działalności organizacji pozarządowych w procesie popularyzacji BIM. Wynikiem analizy krytycznej były oceny oraz dyskusja możliwych przyszłych kierunków wdrażania BIM w Polsce.

Słowa kluczowe: modelowanie informacji o budynku, mandat BIM, wdrożenie, implementacja, proces inwestycyjny